

# MACHINERY

OCT 4, 1961

ONE SHILLING & THREEPENCE

OCT 31 1961

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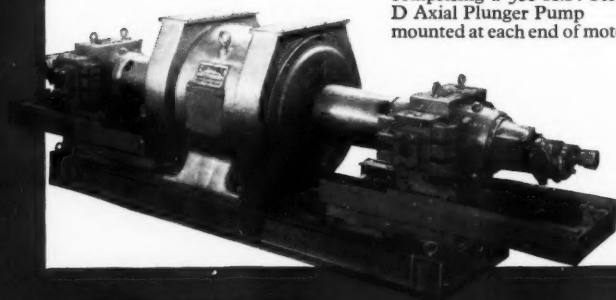
The world's  
largest manufacturer  
of precision toolroom  
grinding machines



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A. JONES & SHIPMAN LTD. LEICESTER. Tel 823222. London Office & Showrooms 50/52 Great Peter Street, S.W.1. Tel. ABBey 590

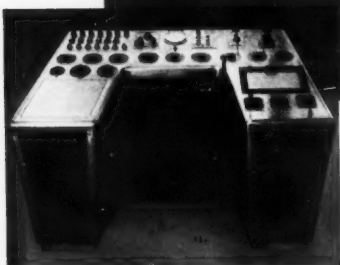
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1,000 H.P. Pump Unit  
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D Axial Plunger Pump  
mounted at each end of motor.

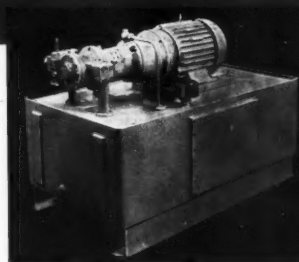
## TOWLER BROTHERS

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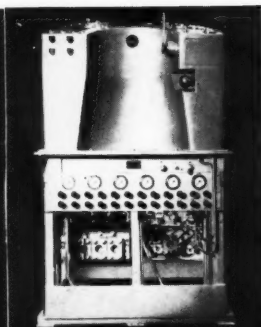
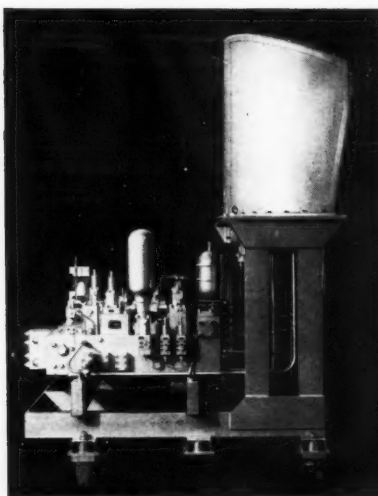


Control desk  
for 2,500 Ton  
Forging Press.

Tank mounted high  
and low pressure  
pump unit.



2 views of a manifold valve station and control desk for  
1,500 Ton Forging Press with monitor panel.



**ELECTRAULIC**  
PUMPS  
CONTROLS  
**AUTODRAULIC**





# RAPID RE-SET

## Face Milling Cutters

Secure

**RAPID BLADE RE-SETTING****RAPID RE-SERVICING****REDUCED CUTTER DOWN TIME****REDUCED CUTTER COSTS**

The Wickman Rapid Re-set system brings even higher efficiency in production milling. Reservicing of Milling Cutters is quicker and simpler by utilizing the off-hand grinding method together with the Special Wickman Rapid Re-set Equipment for Face Milling Cutters.

**RAPID RE-SET EQUIPMENT**

The use of the Wickman Rapid Re-set Cutter Body and three blade styles available provides a simple variation of blade geometry.

The blades can be removed, re-ground, checked and replaced in any Cutter Body size within the range—WITHOUT REMOVING THE CUTTER BODY FROM THE MACHINE, thus reducing down times and costs to a minimum

WRITE FOR YOUR COPY OF THE  
NEW WICKMAN FOLDER  
"WICKMAN RAPID RE-SET FACE  
MILLING CUTTERS"  
FOR THE FULL STORY.

**GRIND**—with special jig**GAUGE**—for accuracy**RE-SET**—in setting block**WICKMAN****LIMITED**

WIMET DIVISION, TORRINGTON AVENUE, COVENTRY.

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## **of our technical advice service?**

Our files are already bulging with case-stories of remarkable improvements in performance, production and economy as a result of visits by our Technical representatives. Many of Britain's large engineering industries are constantly making use of this Service, which in-

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SHEFFIELD ENGLAND**

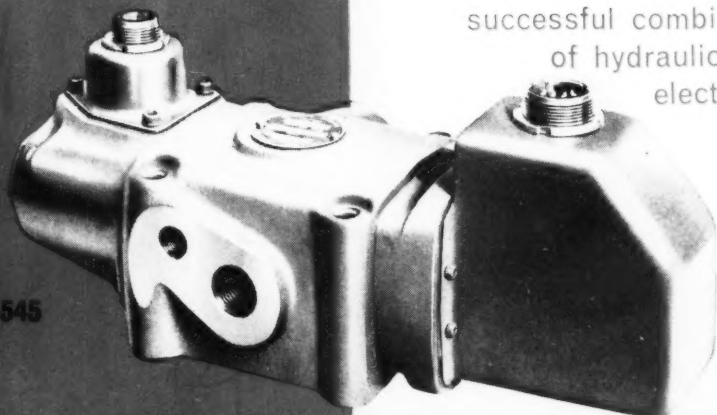
DORMER TOOLS ARE OBTAINABLE FROM YOUR USUAL ENGINEERS' MERCHANTS





**KEELAVITE****Hydraulics****ELECTRO HYDRAULIC SERVO VALVES**

the key to the  
successful combination  
of hydraulics and  
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**Type 5545**

The Keelavite electro-hydraulic servo valve consists of a rotary torque motor driving a pilot valve, which provides one stage of hydraulic amplification, to control the position of the second stage piston.

Two sizes of valve are currently available:

**Type 5545** giving a flow for a pressure drop of 1000 psi of 25-30 gpm., and  
**Type 5572** giving a flow for a pressure drop of 1000 psi at 100 gpm.

The first stage consists of a nominally zero lapped 3-way valve, which is driven against springs by a rotary torque motor. Balanced windings are fitted to the torque motor. These may be either low or high impedance. An inductive rotary pick-up, also driven by the torque motor, is used to close a feed-back loop around the pilot valve.

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**KEELAVITE COMPLETE HYDRAULICS**

- a complete range of units
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**Hydraulics****THE RECOGNISED AUTHORITY ON  
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FOR THE WORLD

ARTHUR BALFOUR & CO LTD. CAPITAL STEEL WORKS, SHEFFIELD ENGLAND.  
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*The*

**Hayes**

**'TRACEMASTER'**

**TYPE TM43/3D**

**HAND  
CONTROLLED  
360° PROFILE  
MILLING**

*with depth control*

**SPECIFICATION :**

Table Size .. 43in. by 11in.

Longitudinal Traverse... 19in.

Cross Traverse .. 9in.

Vertical Hydraulic

Traverse 3½in.

Max. Height Under

Spindle Nose 14in.

9 Spindle Speeds

50-2,400 r.p.m.



**HAYES**  
**ENGINEERS (LEEDS)**  
**LIMITED**

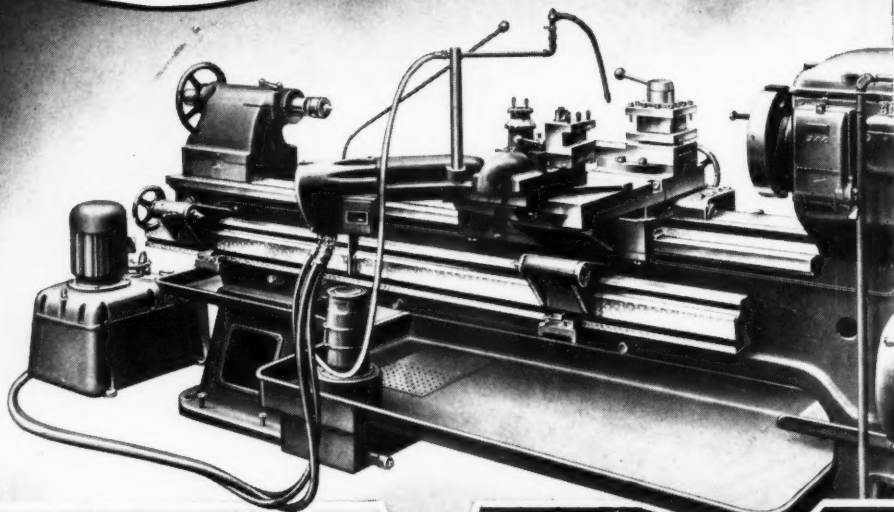
GELDERD RD. LEEDS, 12

Telephone: Leeds 30941

'Grams: Toolmaker Leeds 12

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THE ASSOCIATED BRITISH MACHINE TOOL MAKERS LTD.



# HYDRAULIC COPYING ATTACHMENT

This extremely useful attachment is suitable for all Crowthorn Lathes. (The illustration shows the unit fitted to a 10½ in. Centre Lathe).

Particular advantages of the Crowthorn attachment are as follows:-

1. great reduction in machining times.
2. accuracy does not depend on the skill of the operator.
3. attachment is fitted to existing cross slide at rear of lathe. Front tool post can be used in normal way.
4. round models or flat templates can be used as masters.
5. can be used for boring, face copying and normal external machining.
6. a high degree of accuracy is obtained.
7. slow tapers can be machined and radiused forms easily copied.

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*Makers of High Class Machine Tools for over half a century*

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Phone: STOCKPORT 7271-2-3

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FASTER  
STRONGER  
MORE  
ACCURATE

**Clark Son**  
**S** type AUTOLOCK

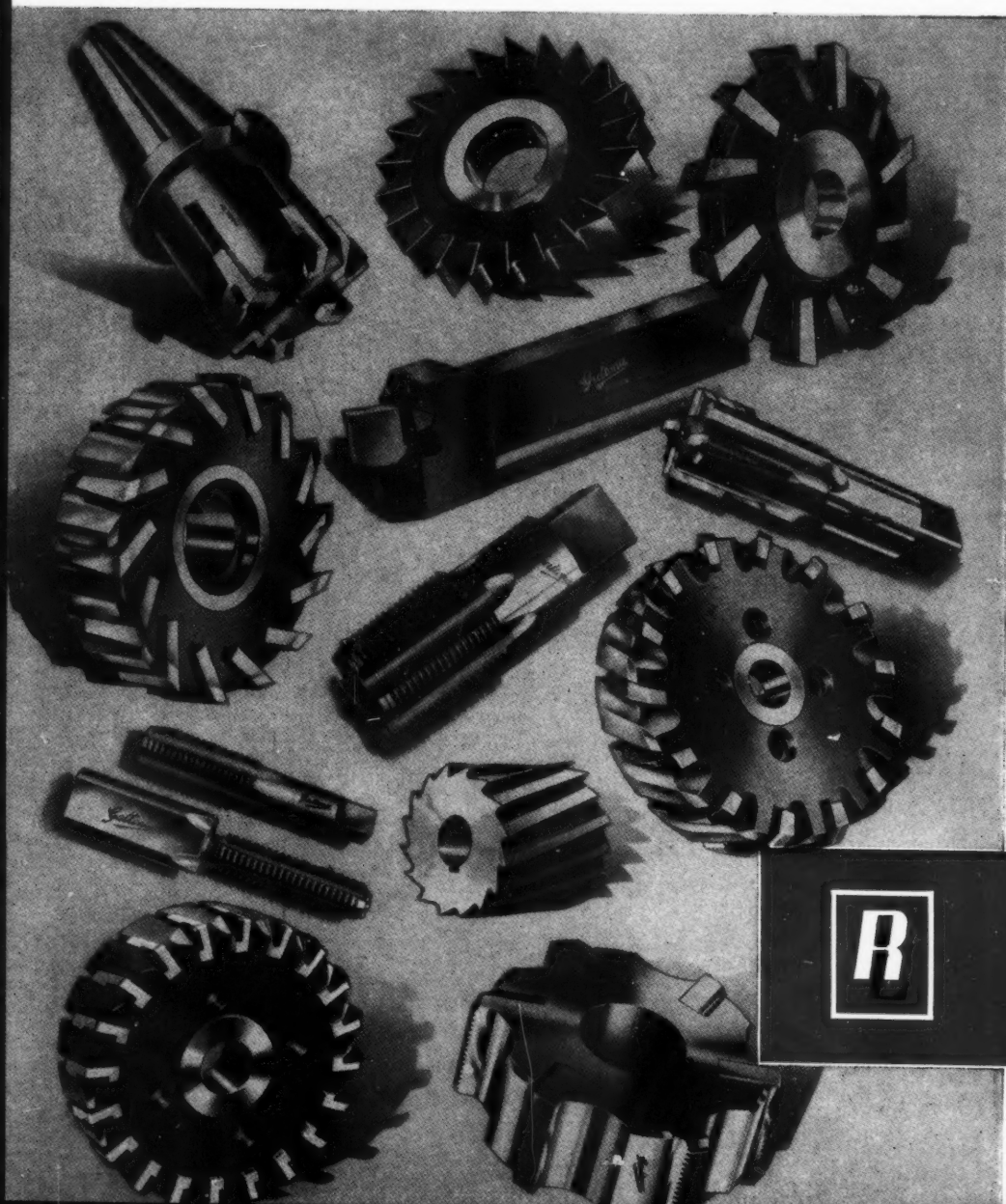
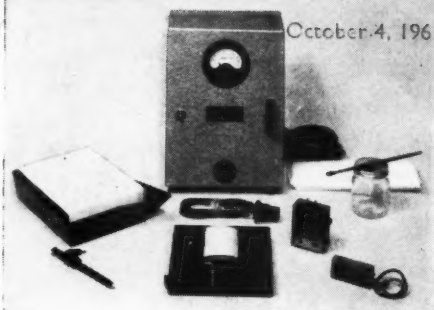
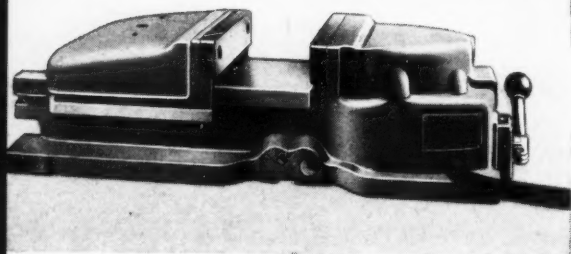
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2 (Cont.)

MACHINERY

October 4, 1961









# ENGINEERS

## RELY ON



### SERRATED BLADE CUTTERS

Economical, adjustable and adaptable, the wide range of types and sizes caters for all requirements. Reasonable in initial cost, they are economical in use since the blades are adjustable to maintain size when regrinding and are replaceable when necessary. Supplied in high speed steel, super Cobalt "Stellite" or cemented carbide tipped. Special tools can be designed for individual needs. Our Cutting Tool Engineers will consult with you on your tooling problems.

### GROUND THREAD TAPS

Unexcelled for accuracy and performance Galtona Ground Form Relieved Taps are thread ground from the solid after hardening. Supplied in all thread forms to B.S. or special tolerances. Large stocks are maintained of standard sizes in all popular thread forms. Specials made to order. Our Tap Engineers are available for consultation on individual problems.

### PNEUMATIC MACHINE VICE

Provides instantaneous grip and release giving considerable increase in production speeds. Rigid and robust construction; air valve mechanism housed in main body casting. Gives constant pressure of  $1\frac{1}{2}$  tons in any gripping position with line pressure of 80 lbs. per sq. inch.

### H.S.S. MILLING CUTTERS

The range comprises all types of Milling Cutters both standard and special including form relieved.

### ELECTROLYTIC MARKING SETS

For quick, economical and neat marking of any typewritten characters, or special devices, trade marks etc. Hardened steel parts—especially finished products—can be marked quickly and neatly. Perfect results even with unskilled operators.

### SERRATED BIT TOOL HOLDERS

For Lathes, Shapers, Planers and Boring Mills. In front and rear lock styles made from nickel chromium heat treated steel. Nineteen shapes of tool bit available in standard H.S. Steel and in our T.15 H.S. Steel for more difficult materials. Also stocked carbide tipped for steel and cast iron.

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GALTON HOUSE, ELMFIELD AVENUE, TYBURN, BIRMINGHAM, 24

Telephone: Ashfield 1801. Telegrams "Cogs. Birmingham"

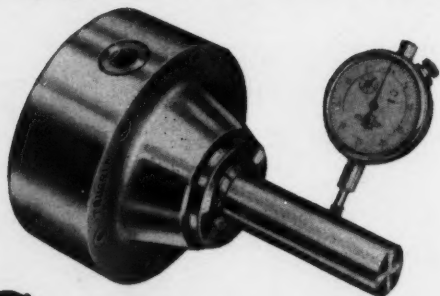
NORTHERN AREA OFFICE: Britannia House, Wellington Street, Leeds, 1. Phone: Leeds 21212.

LONDON AREA OFFICE: 240 Romford Road, Forest Gate, London, E.7. Phone: MARYland 7304-5.

NORTHERN IRELAND: Garage & Engineering Supplies Ltd., 78 Great Victoria Street, Belfast.

SCOTLAND: Stuart & Houston, 5 York Street, Glasgow, C.2.

# 9 Applications to the

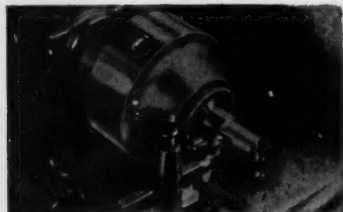


Sizes: 5in. dia., 1in. capacity;  
7in. dia., 2in. capacity

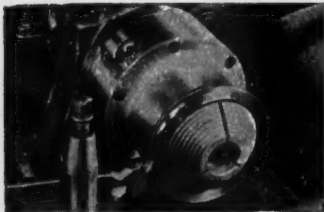
# Crawford

## "TRUGRIP" COLLET CHUCK

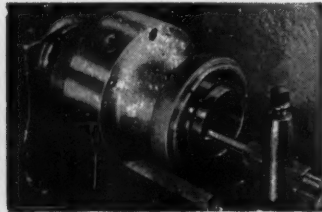
With the Crawford "Trugrip" Collet Chuck, work is held true, instantly, by the turn of a key. Absence of drawtube or sleeve means that full bore of spindle can be used. Powerful, positive action, with no distortion, and no marking of previously machined surfaces, makes it ideal for second operation work. Wide range of collets greatly increases capacity of machine, nine typical examples shown below.



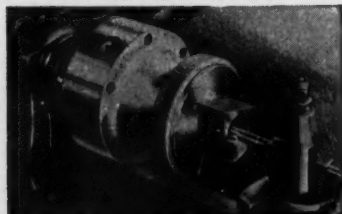
Turning using Standard Collet.



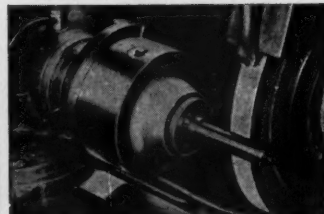
Facing and turning using Ring Collet.



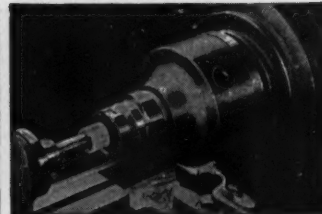
Facing and boring using Disc Collet.



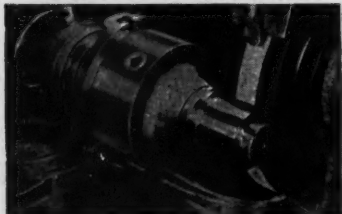
Boring an irregular shaped Component



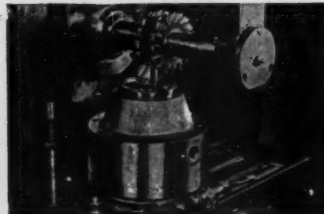
Grinding using Standard Collet.



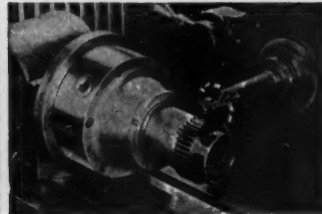
Internal grinding using Oversize Head Collet



Grinding O.D. and face dead true with bore using Expanded Mandrel.



Milling on Index Fixture.



Milling on Expanded Mandrel.

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Agents for North East England: Messrs. Alfred Herbert Ltd., Carlisle Square, Newcastle, I. Tel: NEWcastle 28864

Agents for Scotland: R. McKimming & Co., 65, West Regent Street, Glasgow. C.2. Tel: DOUGlas 7391-2

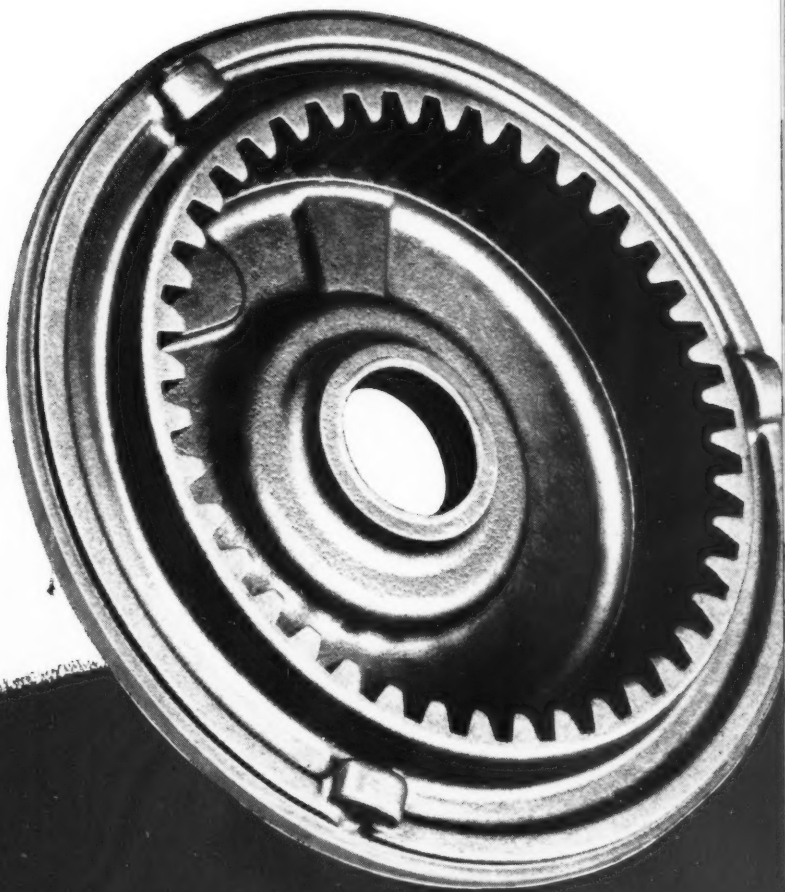
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**When you need  
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**Harpers**

**about them**

Users of castings keep coming to Harpers because nowhere else (they say) can they get consistently the same standard of accuracy in production quantities—precision in iron castings which often eliminates machining altogether, and in every case saves enormously on tooling and machining costs.

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Telephone : Willenhall 66601 (7 lines)

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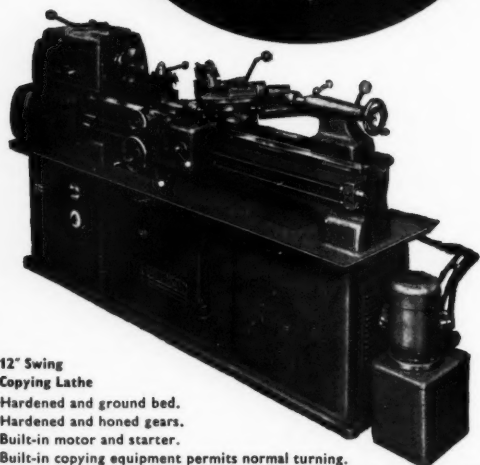
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POOLE FOUNDRY LTD. Poole 212

Also makers of the famous Beatrice Oil Heaters & Harper Housewares

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**FOR  
ENGINEERS  
WITH  
AN EYE  
FOR VALUE...**



**12" Swing  
Copying Lathe**

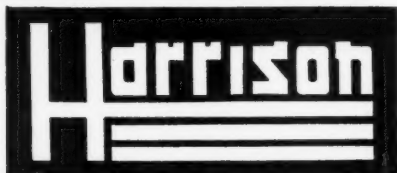
Hardened and ground bed.  
Hardened and honed gears.

Built-in motor and starter.

Built-in copying equipment permits normal turning.

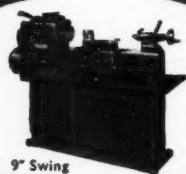
Swing over bed 12". Between centres 24" or 40". Spindle Speeds 45-2000.

**OVER 500 HARRISON COPYING LATHES NOW IN DAILY USE.**

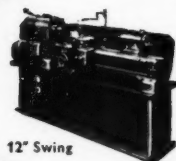


**T. S. HARRISON & SONS LTD. HECKMONDWIKE, YORKSHIRE.**

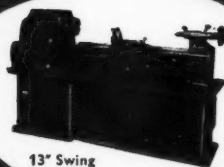
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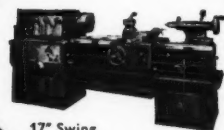
**9" Swing**



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**13" Swing**



**17" Swing**



**G20 Heavy Duty  
Grinder**



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Grinder**



**Lapping  
and Chipbreaker  
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**Tool and  
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*These are available covers the Harrison  
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does you a good turn...

... there are numerous occasions when the use of mechanical tubing can make substantial savings to your labour, time and material costs. If you are engaged in machine shopwork, the manufacture of rollers, or round shaped articles, mechanical tubing can help you. We also have available the full range of pressure tubing.

A comprehensive booklet giving details of our considerable stocks of tubing in various sizes and finishes will prove invaluable to you.

Do yourself a good turn by writing for this booklet NOW!



Also consult us for: ... bearing ... storage tanks ... mild steel fabrications etc.

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LTD

COX GREEN WORKS, BROMLEY CROSS, Nr. BOLTON.

Tel. Easley 600 (5 lines)





I agree... for speed and long life

order



Made by James Neill & Co. (Sheffield) Ltd., and obtainable from all tool distributors



Paint Sw  
hot swag



Rap  
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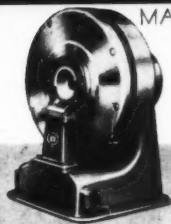
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October 4, 1961

MACHINERY

(Suppl.) 15

Point Swaging Machines Type ASM for the hot swaging of rectangular sections



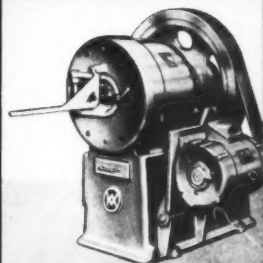
# MACHINES FOR OPERATIONS ON BAR AND TUBE ENDS

High-duty Point Swaging and Reducing Machines Type ASMK for the hot and cold swaging of round sections, particularly for the reduction of drawing tangs on bars and tubes

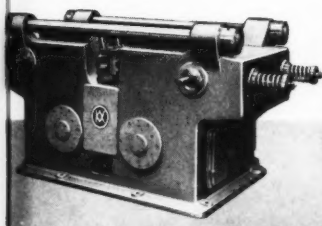


British Agent: F. W. KUBACH Ltd.  
12 Sylvan Road, London S.E. 19

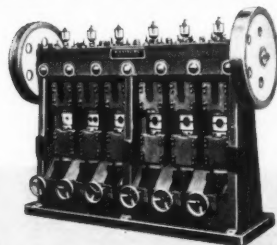
Tube Swaging Machines Type ARK for the cold reduction and swaging of the ends of tubes and bars of low formability, and for forming the inner profiles of tubes over a mandrel



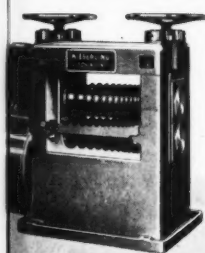
Rapid Hammering Machines Type KRHD in the form of horizontal counter-blow presses with double-sided pairs of side-action tools for the reduction of long tapers by hammering in the hot state, particularly of thick-walled large-diameter tubes



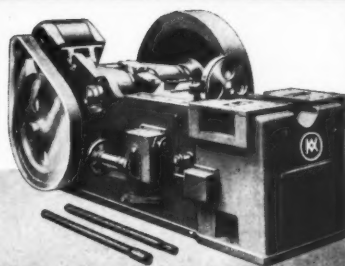
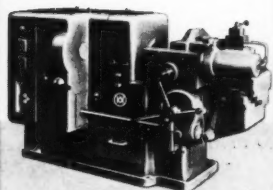
Hammer Swaging Machines for Tubes Type AM in the form of vertical short-stroke multi-stage presses using a number of tools which are actuated vertically from above by individual rams, for the reduction of gripping tangs on tubes in the cold state and for the hot forging of small ironware



Reducing Rolls Type SAWN for reducing the ends of tubes and bars and forming the drawing tangs by means of multi-pass rolls, in the hot or cold state



Tang Milling Machines Type SAM for the metal-removing forming of drawing tangs on large-diameter bars

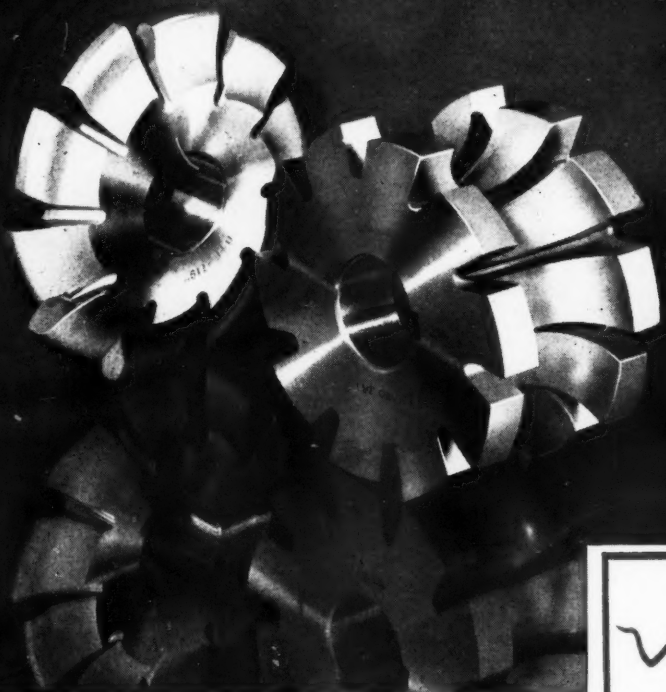


Tube Expanding and Reducing Machines Type REM in the form of horizontal rotary presses for expanding or reducing tube ends in the cold state, e.g. for boiler-making purposes. These machines can also be supplied with automatic tube feeding and removal equipment as the Type REMS



**TH. KIESERLING & ALBRECHT**  
WERKZEUGMASCHINENFABRIK · SOLINGEN

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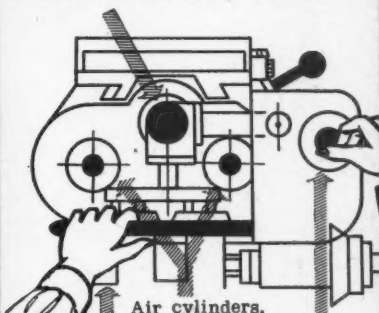
A fast  
automatic  
-cycle miller

with more weight  
more stamina  
more power



Balanced feed control  
from centrally placed  
hydraulic cylinder to  
reduce table-slide wear.

Emergency  
table return  
lever.



TWO HANDED START FOR SAFETY  
Interlock lever must be lifted  
before start cycle button can  
be operated.



*Other models in the No. 1 range*

- A-LSL—Hand Feed
- A-G—Automatic Feed
- A-J—Automatic Cycle

## MODEL 1 HORIZONTAL MILLER

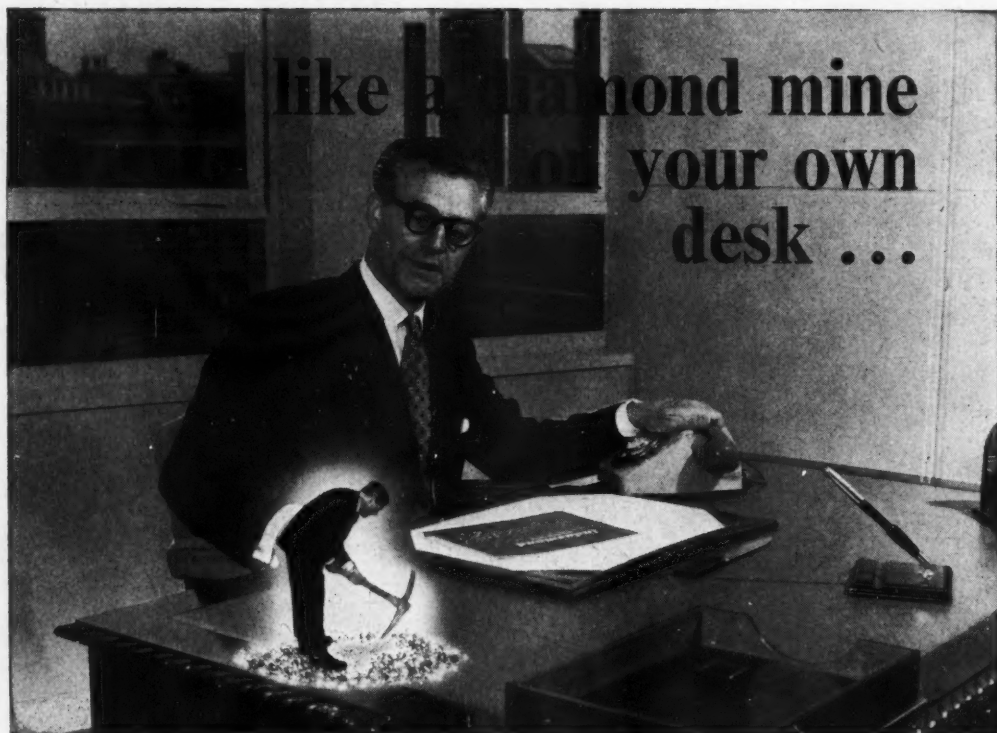
### Air Hydraulic Automatic Cycle

No comparable miller has the weight and the power of the air-hydraulic A & S Model 1. 1,400 lb. weight, 2 h.p. strength and three bearings to spindle give this superb machine the speed, brawn and stamina no other air hydraulic miller can touch. By air-hydraulic table drive (powered by the shop air supply) greater cutter life, immaculate finish and faster automatic cycles are achieved. Two air cylinders exert balanced thrust on the table slides, eliminating side thrust wear, and safeguarding the unfailing accuracy of the machine. With two hand controls and an emergency return lever, the A & S Model 1 is also the safest of all millers. Write for illustrated brochure on A & S Model 1 Range.

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*This Catalogue should be on your desk. It gives full details of wheel dressing and wheel forming diamond tools; diamond tools for turning, boring and hardness testing; diamond impregnated wheels and laps, in fact everything you need for selecting the right diamond tools for your operations. Send for your FREE copy now!*



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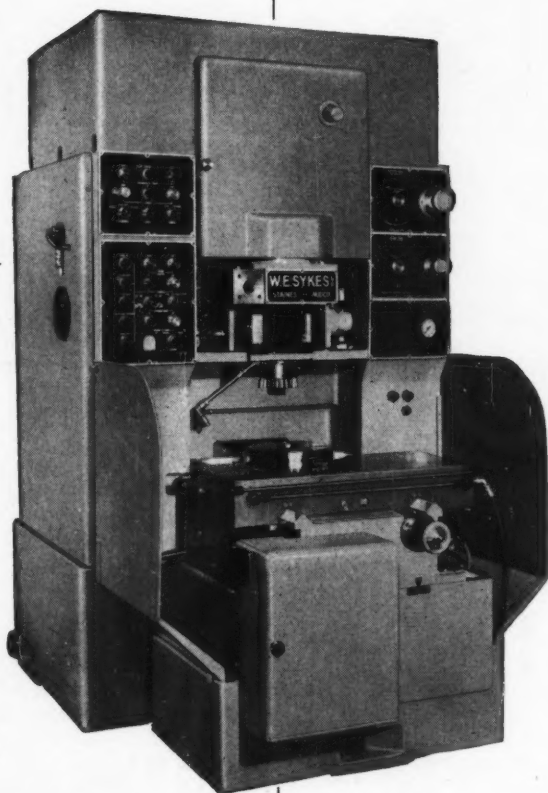
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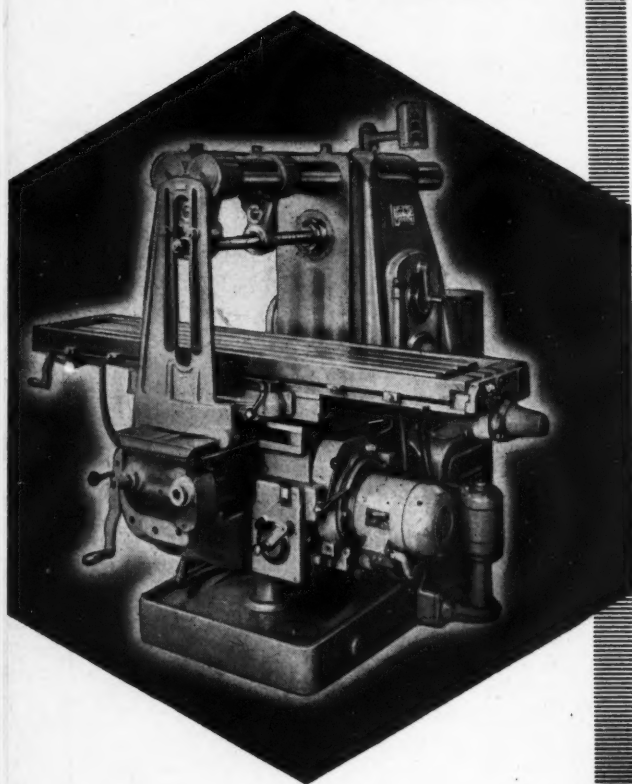
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*for ease,  
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economy of  
operation . . .*

## **7½ h.p. — 3CE UNIVERSAL MILLING MACHINE**

### **SERIES INCLUDES**

- 3 h.p. 2CE
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All available in plain, universal and vertical styles. Both plain and vertical machines can be fitted with automatic cycle table control.

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16 feeds— $\frac{1}{4}$ —25 i.p.m.

Independent feed drive motor

Rapid traverse in three directions.

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Where a heavy article must be positioned *before* it is bolted to concrete, brickwork or masonry — use Expandabolts. If the machinery or equipment can be placed over a bolt previously fixed — choose Anchor Bolts.

Both these simple fixing devices provide a secure anchorage which remains firm under the most violent movement.

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A hole is made and the complete bolt (set screw, saw-toothed split-sleeve and cone wedge) is placed in it. The set screw is removed and the article placed in position. The set screw is reinserted and tightened. This draws the wedge into the split-sleeve, forcing the saw-teeth to grip the concrete.

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A hole is made, the bolt is inserted and the wedge is driven into the lead spreader, thus locking the bolt in position. The article to be fixed is then placed over the protruding bolt, and the nut is tightened.

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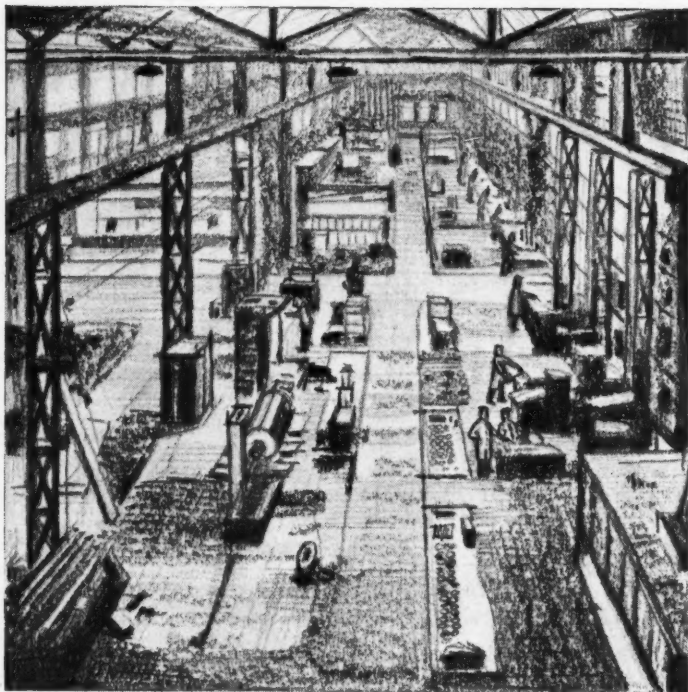
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### AT YOUR SERVICE

Let's say you have a special job to do, and you doubt if it will pay you to tool up specially for it. Then you call in the Carron technical advisory service. We are used to this sort of problem. Through us you can use Carron's vast plant capacity for components. We have at our disposal 300 acres of plant for casting, forging, machining, enamelling, and sheet metal fabrication. We can give you a quote. Then we do the job for you. Quickly and efficiently.



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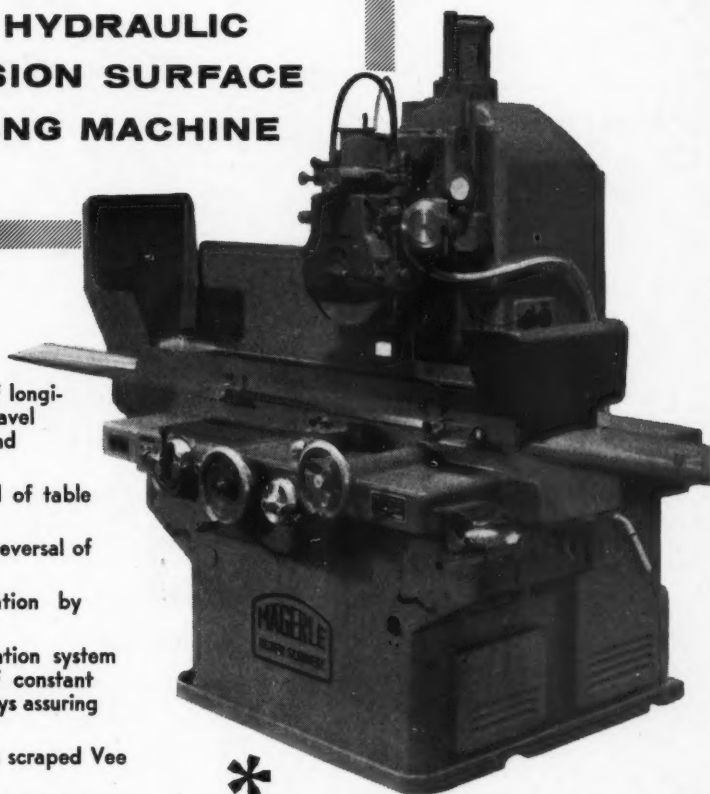
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## FULLY HYDRAULIC PRECISION SURFACE GRINDING MACHINE

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- Infinitely variable control of table speeds and dresser.
- Fully cushioned, smooth reversal of table.
- Extremely simple operation by modern controls.
- Efficient capillary lubrication system maintains an oil film of constant thickness on the table ways assuring maximum precision.
- Strongly ribbed bed with scraped Vee and Flat guideways.
- Independent drives for hydraulic pump, grinding spindle and rapid feed of wheel head.
- Accurately to  $\pm 0.00004$  mm. functioning vertical and transverse movement.
- 5 h.p. Spindle Motor.



### Automatic grinding wheel down feed

*Automatic feed of the wheel-head can be regulated from 0.0001" to 0.0005" and is controlled by the reversal of the work-table longitudinally or transversely.*

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# For *Rapid . . . .* Precision Gear Grinding



SWISS

**REISHAUER****GEAR GRINDER MODEL NZA**

Operating on the continuous worm generating principle, REISHAUER Gear Grinders are exceedingly rapid and precise. There are no facets and no burning of the teeth. Set-up is simple and can be performed quickly. Single gears can be ground as economically as batches. Changeover from roughing to finishing is automatic – grinding to finished size also. Tip and root modifications can be easily incorporated. Crowning can be performed – and two-way grinding. Both spur gears and spirals up to 45° can be ground – fine pitch gears from the solid. A wheel truing device is incorporated.

Work diameter  $\frac{1}{8}$ " to 11 $\frac{1}{2}$ ". Pitches 48 to 5DP.

Also the REISHAUER DS for lapping diamond wheel-truing tools.  
Other models made by REISHAUER:  
OZA, without truing device and ZB for gears up to 27 $\frac{1}{2}$ " dia. 3 $\frac{1}{2}$  DP.

Send for the fully illustrated brochure M/198.



198

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For *Rapid, Accurate, Economical*

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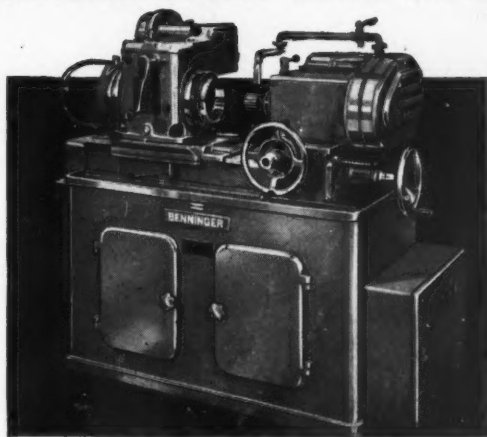


## BENNINGER

(Swiss)  
UNIVERSAL THREAD MILLER GFU 16

For the more important threading jobs, particularly on difficult materials, you cannot beat the BENNINGER. Equally at home on bulky work or delicate thin-walled components, it is simple, economical and extremely versatile. Almost any thread form can be produced—external or internal, right-hand or left, parallel or tapered, in blind holes or up against flanges, accurately to the last thread—and worms. The BENNINGER is more economical too, because a number of machines can be tended by the one 'semi-skilled' operator.

*For diameters .16" to 9.45" external, .4" to 13.98" internal. Spindle bored 6.3" right through. Max. thread length: with leader and follower 2.8", with leadscrew 14.5". Pitches 50 to .5 t.p.i. Cutting times 38 sec. to 19½ min.*



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AT OUR  
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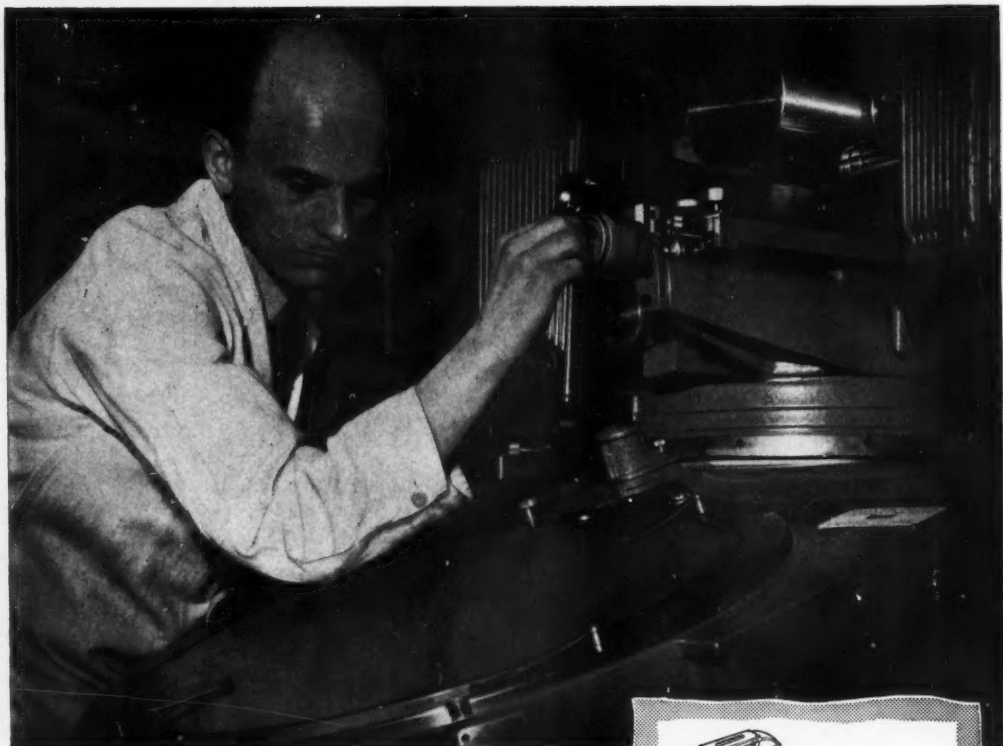
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# INSPECTION — *the foundation of quality*



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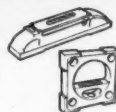
As agents for Sigma, Hilger & Watts, Coventry Gauge, Pitter Gauge and Tool, Avery and others, we offer the most comprehensive metrology service in this country.

**Send for a copy of our general measuring catalogue, over 150 instruments illustrated.**

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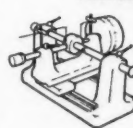
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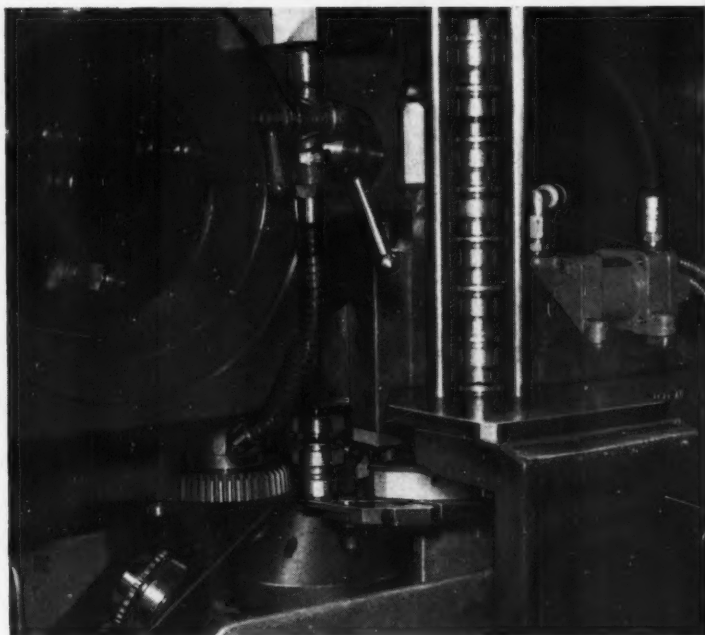
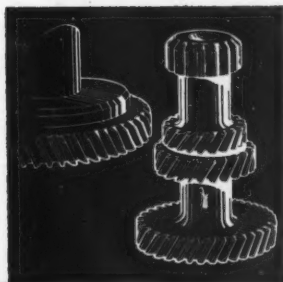


MICRO-HARDNESS TESTER

high-speed shaping of spur and helical  
gears on the British-made

# FELLOWS-ENGLAND

TYPE 7125A GEAR SHAPER



A fully-automatic cycle can now be obtained on the Fellows-England Type 7125A Gear Shaper, for suitable gears. Repetitive accuracy in locating and clamping, is assured.

The above illustration shows the principle applied to cutting a 30T, 12 D.P. 0.16" face width, spur gear whilst alongside, a layshaft cluster gear, the 2nd speed gear of which is cut in a cycle time of 3 minutes 4 seconds. The latter employs a transfer arm which loads and unloads from a conveyor which is part of a 27-station in-line transfer machine.

The Fellows-England Type 6 A.H. Gear Shaper, cuts gears up to 20" (external), and 18" (internal) pitch diameter, up to 3/4 (spur) 4/5 (helical) D.P., maximum face width 5".

The PATENTED FEED CAM TRIP MECHANISM fitted to Fellows-England Machines allows accurate control of cutter over-run to avoid dropped-tooth production.

## SPUR GEARS

External up to 10" P.D. at 6 D.P.

Internal up to 6" P.D. at 6 D.P.

## HELICAL GEARS

External up to 7" P.D. at 6 D.P.

Internal up to 6" P.D. at 6 D.P.

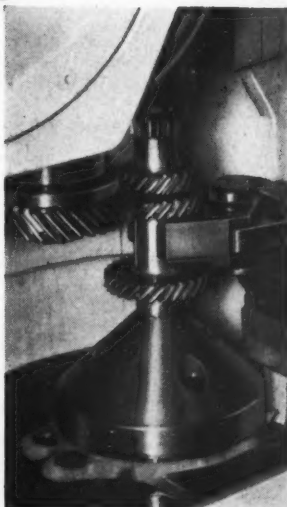
Helix Angles from 5° to 45°

## RANGE OF CUTTING SPEEDS

6 speeds from 156 to 515 strokes per min.

## CUTTER FEEDS PER STROKE

Eight feeds from .006" to .0013" per inch dia. of cutter



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**HERBERT**

LTD., COVENTRY

AD 620



Material cost per item is less than that of other non ferrous metals.

Clean modern appearance.

Can be anodised—clear or colour.

Automatics can operate at maximum feeds and speeds.

Small chips eliminate swarf "build up" at tool tip.

*Write TODAY for Full Technical Details.*

*Specify*  
**ALMINAL**  
**152**

**ALUMINIUM ALLOY  
 FREE MACHINING BAR**

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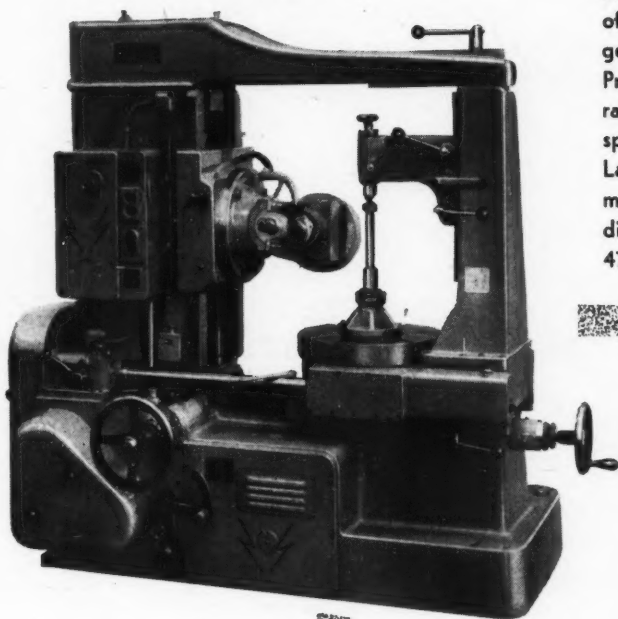
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The Almhult KFI is designed for economic, precision hobbing of single, large or small batch gears.

Produces spurs, helicals, ratchet wheels, worms and splines.

Larger machine available, model KF2, maximum gear diameter that can be hobbed 47".

## ÄLMHULT AUTOMATIC GEAR HOBBER KFI

### SPECIFICATION

Max. gear diameter that can be hobbed	23½"
Min. centre distance, cutter spindle-table	1½"
Vertical travel of hob head slide ..	17½"
Table diameter ... ..	19½"
Table worm wheel indexing diameter ...	16"

\* *ECONOMIC*

\* *ACCURATE*

\* *VERSATILE*

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**EXCLUSIVE**

DISTRIBUTORS OF THE FINEST MACHINE TOOLS

MORTIMER MACHINE TOOL CO. LTD • MORTIMER HOUSE • ACTON LANE • LONDON NW10 • Tel: ELG 3834-5-6

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Number three running hot again?  
Right, I'll send a man down.

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Take any heavily stressed bearing — there'll be several in your works. Pressure, heat, or the washing action of water or chemicals breaks down the lubricant cushion between bearing surfaces. Rapid metal to metal wear takes place and the bearing fails — so frequently that *you* now accept it as a normal, inevitable rate of replacement. Call it component failure? That's the outcome, certainly—but the cause is lubrication breakdown.

This is where Molytone Grease goes into action. Combining Molybdenum Disulphide with highest quality, all-purpose non-melting grease, it is tough, stable, and long wearing, easily withstands extremes of pressure and temperature—often cutting maintenance frequency by more than half.

Here's just one of the problems solved by **MOLYTONE GREASE**. Number of replacement bearings reduced to **ONE FORTIETH**.

**Industry: IRON & STEEL**

**Problem:** Lubrication of 14" mill fabric bearings constantly washed with water. Average replacements were 21 bearings per week.

**Solution:** **MOLYTONE 265 GREASE** fed through a pressure system. Replacement bearings now average only 1 every 16 weeks.

**When ordinary oils and greases fail—  
MODERN ENGINEERS TURN TO**

# Rocol

## MOLYTONE GREASE

Write today for comprehensive literature on **MOLYTONE GREASE** and other Rocol Molybdenised Lubricants — and remember, if you have a lubrication difficulty, Rocol's expert Technical Representatives are always on call.

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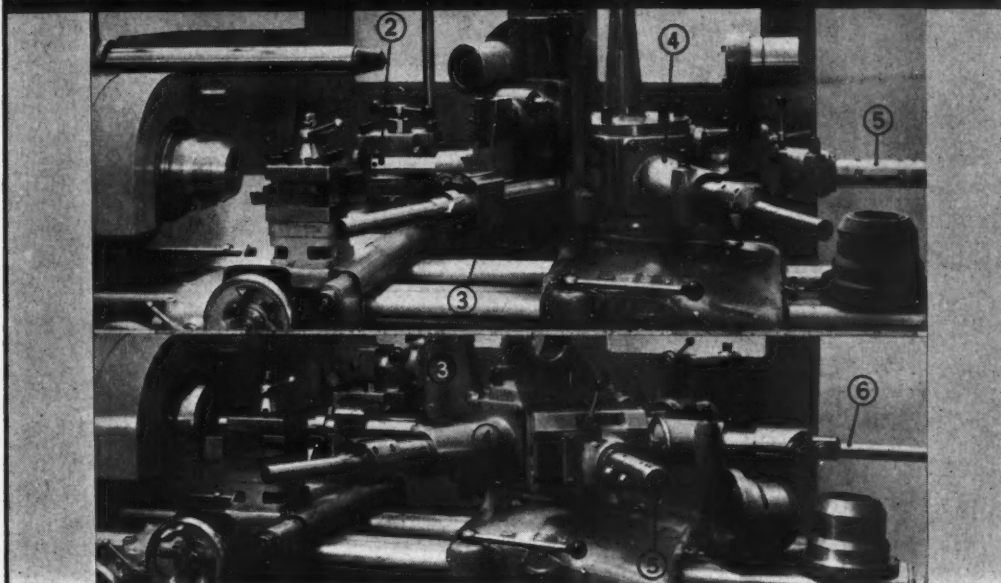
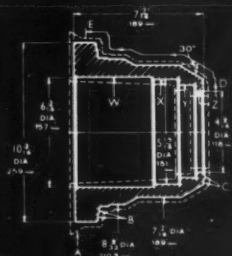
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**SPECIAL**

## TOOLING LAYOUT No. 18



**CAST IRON**  
Machined all over.

## PULLEY SLEEVE

### Tungsten Carbide Cutting Tools.

## No. 10 TURRET LATHE

Code Word : **Covhynant**

Equipped with Hydraulic Copy Turning Attachment  
and 18" — 3-Jaw Tudor Chuck.

**Floor to Floor Times :**  
**1st Process 15 mins.**  
**2nd Process 15 mins.**

DESCRIPTION OF OPERATION	Tool Position		Spindle Speed R.P.M.	Max. Cutting Speed		Feed	
	Hex. Turret	Cross- slide		Feet per min.	Metres per min.	Cuts per inch	m/m. per rev.
1st Process							
1. Grip on "A" in 3-Jaw chuck using loading attachment.	1	—	—	—	—	—	—
2. Rough bore "Z".	—	—	125	149	45.4	124	.205
3. Rough double face "B" & "C".	—	S.T.	125	344	105	124	.205
Copy turn "D" to "E".	—	—	—	—	—	—	—
1st cut — Roughing	—	Rear	125	344	105	64	.397
2nd cut — Finishing	—	Rear	240	647	203	124	.205
4. Remove from chuck using unloading attachment	1	—	—	—	—	—	—
2nd Process							
1. Grip on 7 $\frac{1}{8}$ " dia. in 3-Jaw chuck	—	—	—	—	—	—	—
2. Rough face end (two cuts)	—	S.T.	125	368	112	64	.397
3. Rough turn 10 $\frac{1}{8}$ " dia. (two cuts)	—	S.T.	125	344	105	64	.397
4. Rough bore "Z" & "W" dia. and knee turn 10 $\frac{1}{8}$ " dia.	3	—	155	413	126	64	.397
5. Rough bore "Y" & "X" dia.	4	—	155	241	73.4	64	.397
6. Undercut and chamfer bores	5	—	125	207	63	Hand	Hand
7. Microbore "Y," "X" & "W" dia.	6	—	240	389	118.5	88	.289
8. Remove from chuck	—	—	—	—	—	—	—

**'PRELECTOR'**  
Combination Turret  
Lathes  
with Preselective  
speed-changing.

**TURRET LATHES**  
with capacities up  
to 35 in. swing over bed

8½ in. to 2½ in. 'D-S'  
**DOUBLE-SLIDE**  
Capstan Lathes  
for heavier  
accurate work.

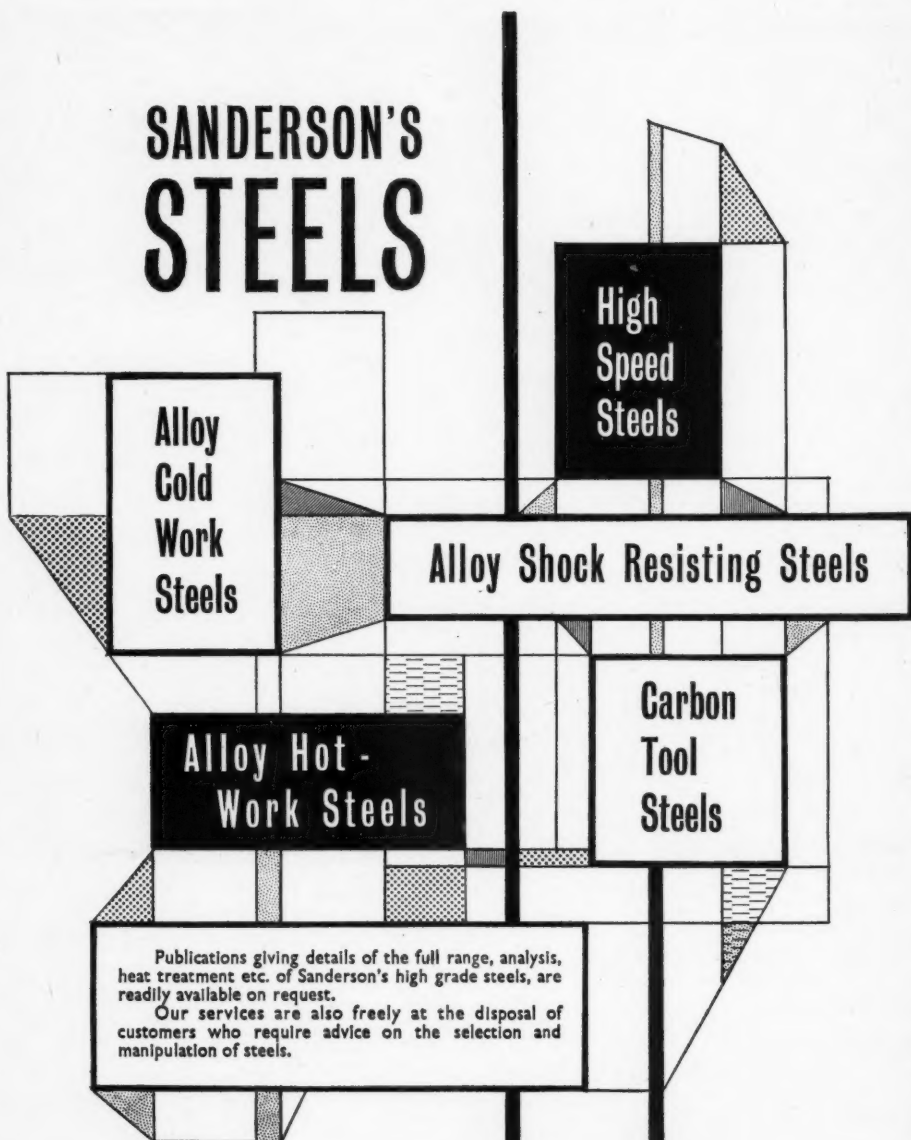
**Stock Tools,  
Toolholders, Chucks  
and Accessories  
for Capstan and  
Turret Lathes.**

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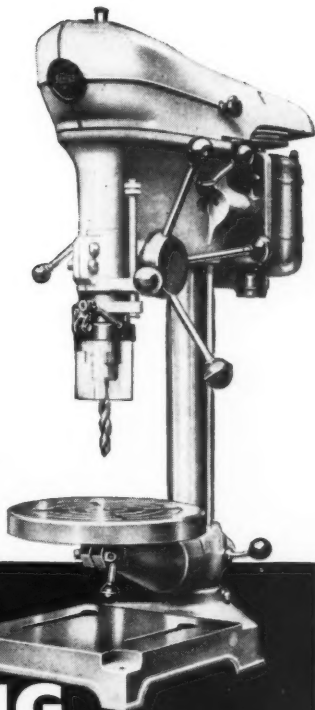


# KERRY

## KERRY $\frac{3}{4}$ INCH CAPACITY SUPER "8" SPEED DRILL

A production and general purpose jobbing machine, robustly constructed to ensure absolute reliability under the most arduous operating conditions. Features that have made this Super "8" so popular include a wide speed range — from 86 to 3,360 r.p.m. or 45 to 2,000 r.p.m. and adaptability for such applications as drilling, reaming, tapping, lapping, trepanning, etc. Tens of thousands are in use throughout industry today.

The Super "8" is available as a bench, pedestal or line production model together with a complete selection of attachments for special application.



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### THE KERRY "DRILLMASTER"

A  $\frac{1}{2}$  inch capacity production drilling machine designed for continuous operation over long periods. The "Drillmaster" can be supplied with a low, standard, or high speed range to suit customers' requirements. Each model has 4 spindle speeds ranging — in the low speed machine from 300 to 2,200 r.p.m. — the standard from 617 to 3,360 r.p.m., and the high speed machine up to 7,000 r.p.m. Bench, pillar and line production models are available in the above speed ranges.

**KERRY'S**

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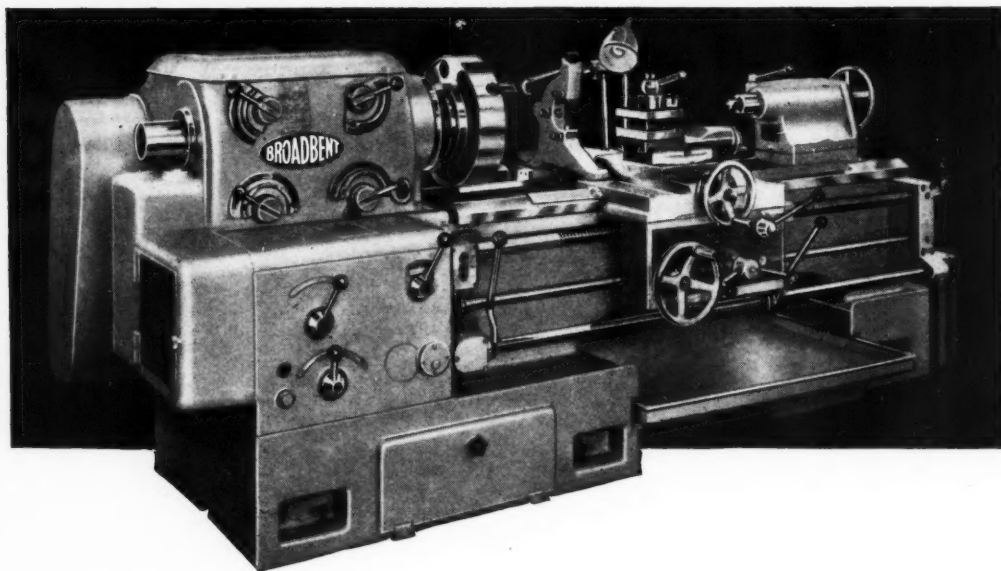
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# MORE output per man-hour with

Good men plus good tools equal good output. Every Broadbent lathe incorporates almost a century of machine tool building. Manufacturers know that for versatility, accuracy and reliability there is nothing quite as good as a Broadbent Machine Tool.

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This 18/22" Swing Heavy Duty Centre Lathe of modern design is a typical example of the Broadbent range. It has a 15 h.p. drive motor and spindle speeds up to 1,000 r.p.m.

The Broadbent range of Machine Tools includes Surfacing and Screw-cutting Lathes from 17" to 72" swing, Surfacing and Boring Lathes, Break Lathes, Crankshaft Lathes and vertical Turning and Boring Mills with 5', 6', 8' or 10' capacity.

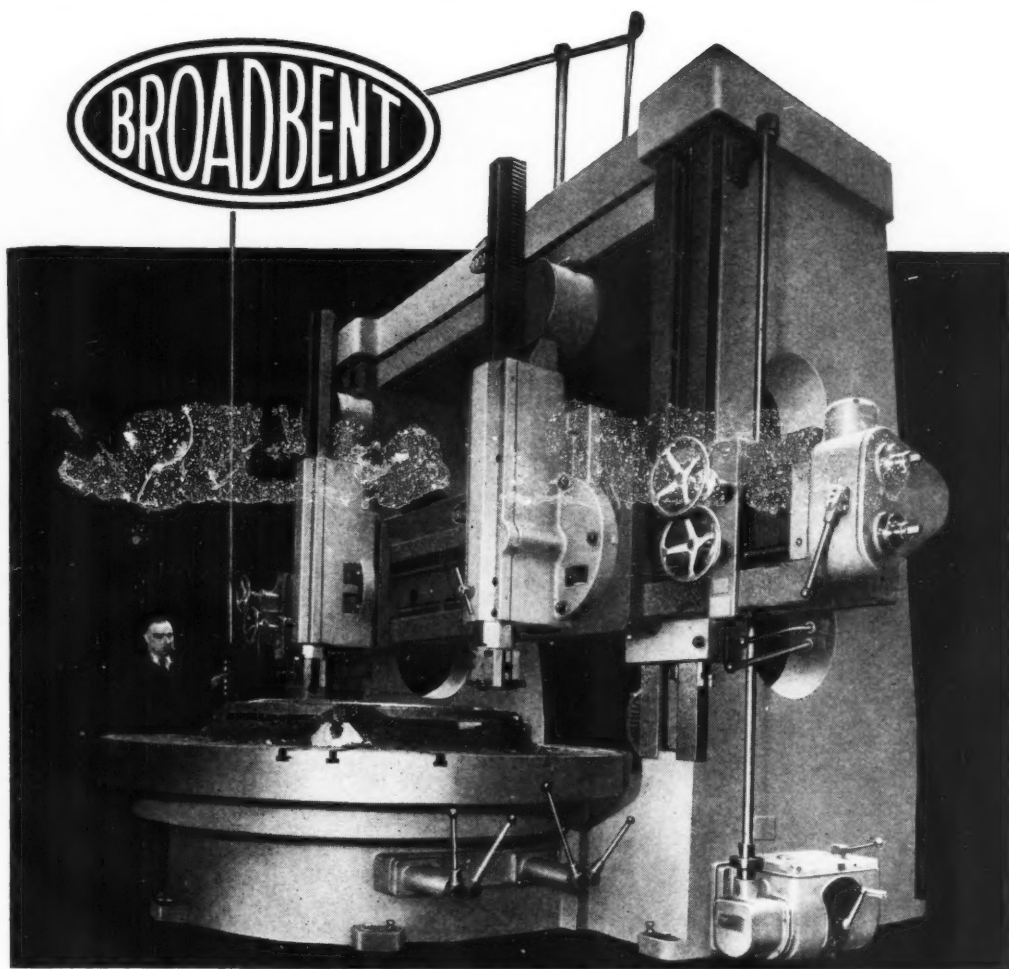


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a **Kerry** COMPANY

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Broadway/HBB



## HEAVY DUTY Vertical BORING & TURNING MILLS with 5, 6, 8 or 10 ft diameter work tables

These incomparable machines are massively constructed for years of hard service. Accuracy and dependability are of the high order that industry has learned to expect of Broadbent Machine Tools. Notable features of these Boring and Turning Mills include twelve changes of speed and six changes of feed, controllable from either side of the machine; spiral bevel and spur reduction gears driving the work table; pendant control of rams and cross slides; and rapid power traverse with independent control of the two heads.

*Please write for fully illustrated brochure.*



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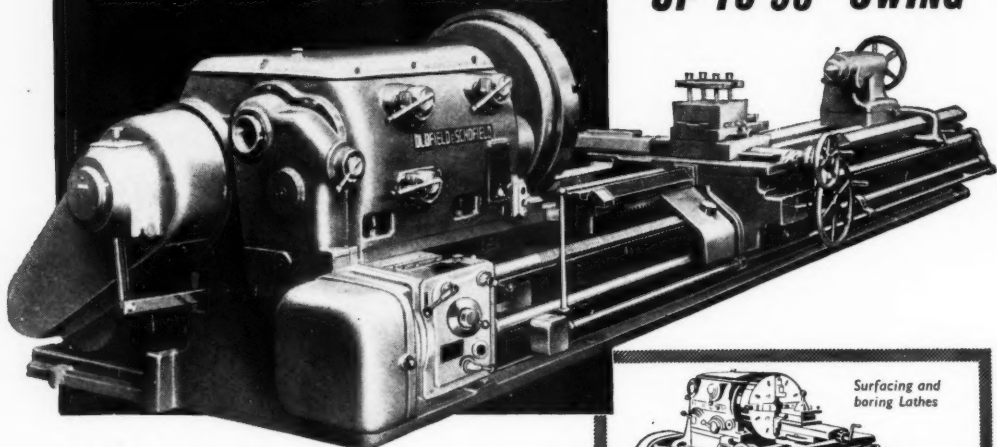
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*Broadway 1188*

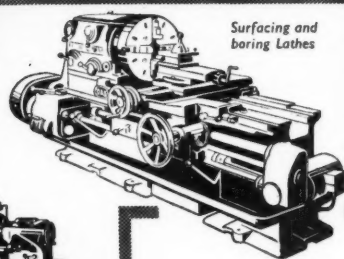
# Heavy Duty LATHES



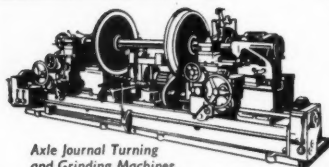
**UP TO 96" SWING**



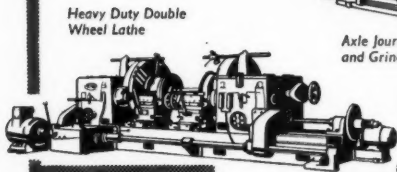
*18½" Centre 'D' Type Lathes. Built in sizes up to 48" swing.*



*Surfacing and boring Lathes*



*Axle Journal Turning and Grinding Machines*



*Heavy Duty Double Wheel Lathe*

O & S have for many years manufactured a wide variety of heavy lathes which have earned for the company a fine reputation for precision engineering and first class craftsmanship. The range includes Surfacing and Boring Lathes up to 96" swing, Brake Lathes, Axle Lathes, railway carriage and waggon wheel lathes, axle journal turning and burnishing lathes etc., all embodying the latest developments in modern lathe design.



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**OLDFIELD & SCHOFIELD CO. LTD**  
BOOTH TOWN, HALIFAX, YORKSHIRE

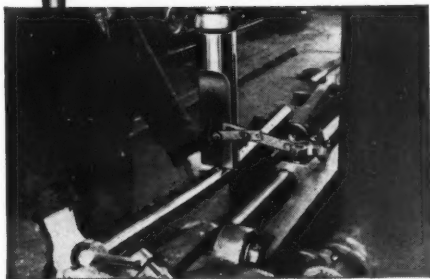
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Sales Office: WARTON ROAD, STRATFORD, LONDON, E.15. Telephone: MARYland 6611



## STRAIGHTENING PRESSES

O & S Straightening Presses, made in 5 sizes with capacities ranging from 4 to 60 tons pressure, have for many years been the first choice of engineering firms throughout the world, including most of the leading motor manufacturers. For speed, accuracy and ease of operation, O & S Straightening Presses are in a class of their own.



*In the Leicester works of Frederick Parker Ltd., O & S Straightening Presses are in daily service ensuring that steel shafts are perfectly straight and true.*

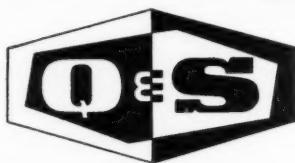
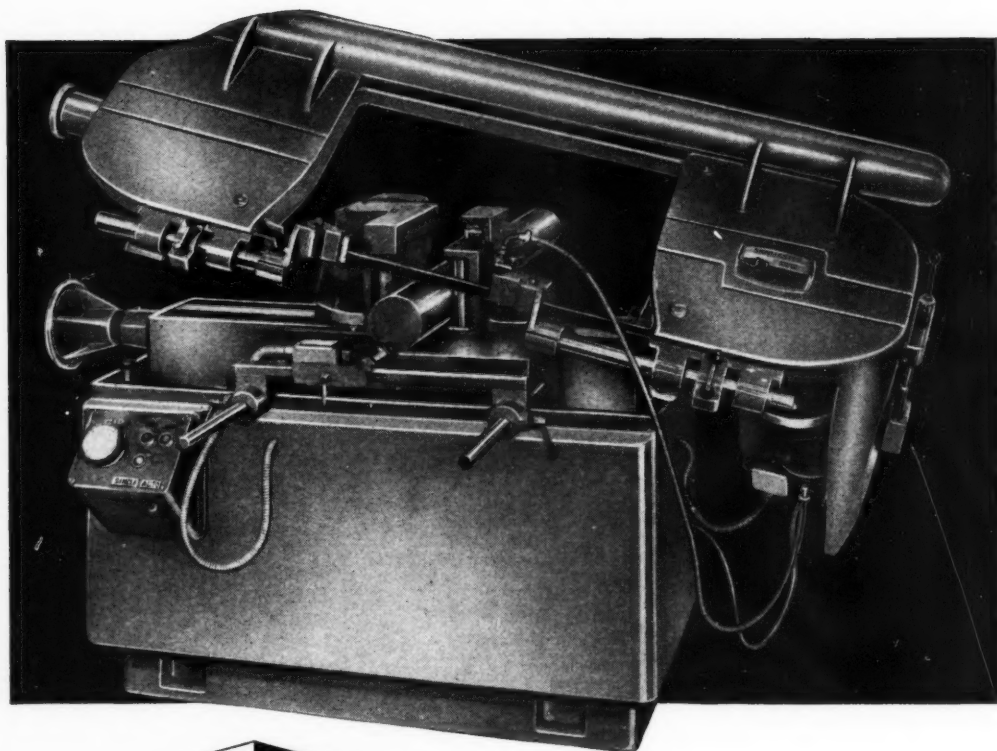


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**SAWMASTER**  
**TYPE 10B AUTOCUT**  
**HEAVY-DUTY**  
**BANDSAW**

**For higher production**

Infinitely variable cutting speeds, accurate blade guidance, faster cutting times, power lifting and lowering of sawframe, simplicity of operation and of blade changing mean higher production than with any comparable saw. The completely automatic cutting cycle facilitates repetition work.

*the British made Bandsaw  
 that is in the world's top class*

*—and the famous SAWMASTER Power Hacksaws 6" 8" 10" or 12" capacity*



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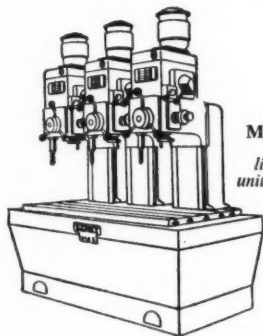
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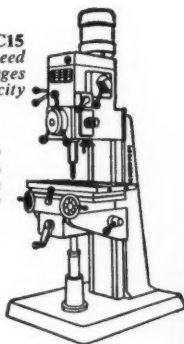
*Broadway/Q59*

# KERRY

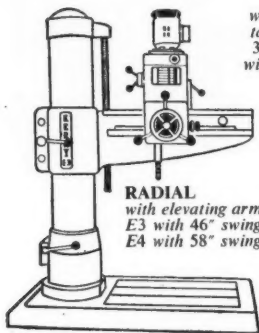
## RANGE OF DRILLING MACHINES



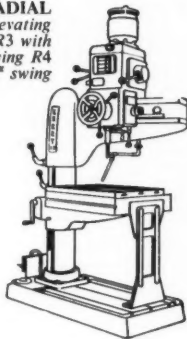
**TYPE C15**  
three speed  
ranges  
1½" capacity



**MULTI-HEAD  
MS 3**  
line production  
unit 1½" capacity

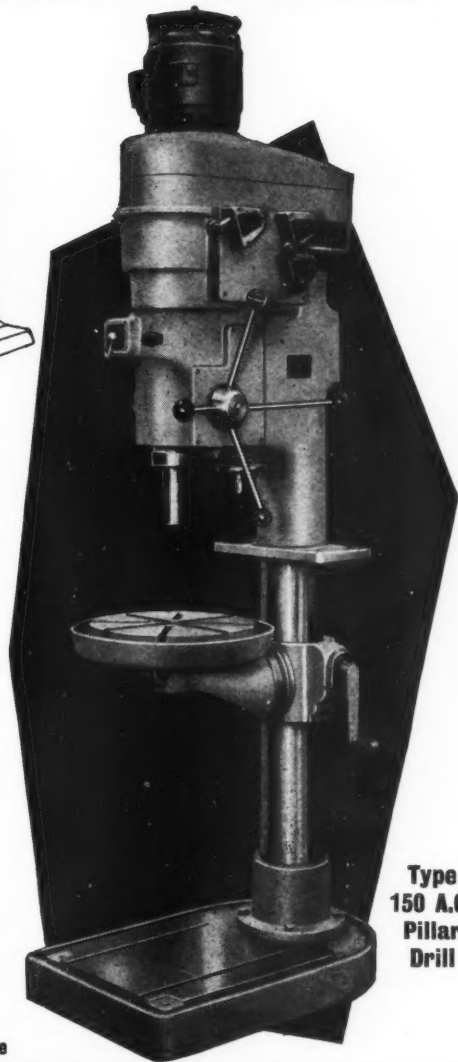


**RADIAL**  
with elevating  
table R3 with  
36" swing R4  
with 48" swing



**RADIAL**  
with elevating arm  
E3 with 46" swing  
E4 with 58" swing

The Kerry 150 A.G. is a versatile, heavy-duty Pillar Drill at a reasonable price which will give long and reliable service under hard working conditions. This 1½" capacity all-gear model has 9 spindle speeds from 85-1,050 r.p.m., 3 ratios of power feeds and reverse to spindle for tapping. The table may be revolved 360° or swivelled to 90° either way for angular drilling. The 150 IV. model is infinitely variable, with similar capacity and specification. These are just two of the wide range of Kerry Bench, Pillar and Line production models with drilling capacities from ½" to 1½"—all first-class machines for their respective applications.



**Type  
150 A.G.  
Pillar  
Drill**

Full details from your Machine Tool Merchant or our Sales Office



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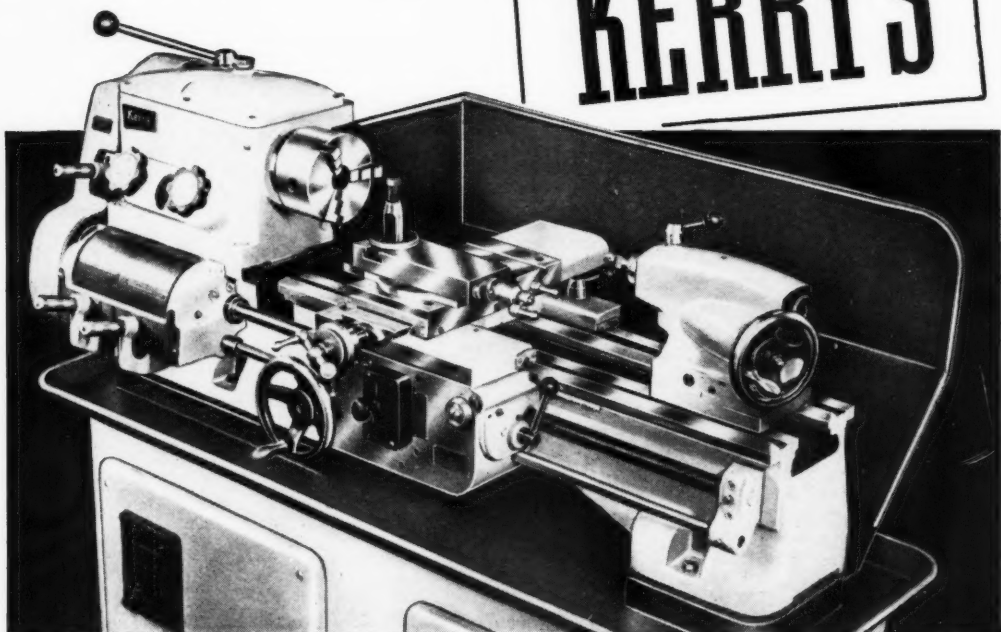
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Broadway/QS 12

**MORE AND MORE  
ARE TURNING TO**

**KERRY'S**



## **11" SWING LATHES**

*THOUSANDS in use in Great Britain  
and throughout the World!*

- ★ SLIDING, SURFACING AND SCREWCUTTING LATHE
- ★ ALL GEARED HEADSTOCK GIVING 9 SPEEDS RANGING FROM 39-1500 r.p.m.
- ★ TYPE LOO PRECISION TAPERED SPINDLE NOSE
- ★ FEED BOX GIVES 62 PITCHES AND 7 FEEDS FROM .0004 in.-.024 in.
- ★ CAMLOCK TAILSTOCK
- ★ BEDWAYS AND SLIDES PRECISION GROUND
- ★ HARDENED BEDWAYS OPTIONAL EXTRA

**KERRY'S**

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A **Kerry** COMPANY

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There are no better pulleys  
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**\* Stock Pulleys  
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SPECIALS**  
ONE OFF OR QUANTITIES

**V-BELT  
COM-PAC Wedge V  
LINK-V**  
AND SPECIAL GROOVING



*Stocks of Atlas  
TAPER BUSHED  
V PULLEYS*



*Stock & Standard  
Cast Iron V-PULLEYS*



OFF-SET  
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FLANGE  
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DRUM



STEP  
CONE

**\* Top Engineering Quality  
\* Competitive Prices and  
Deliveries**

**The London Shafting & Pulley Co. Ltd.**

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Telephone: VERNIAN 4731, 4732, 4733, 4734. Telegram: Gharley, Harde, London.

Attach this cut-out to your letter heading

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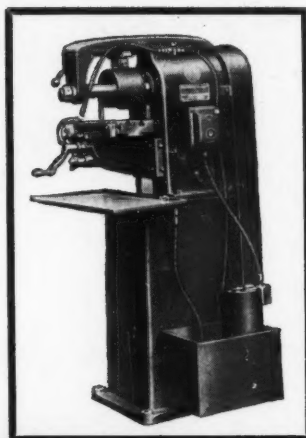
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# AJAX AJ8 MILLING THE FAMOUS



## PISTON RINGS

*Photograph: courtesy of Hepworth & Grandage Ltd., Bradford.*



On the piston ring production lines at Hepworth and Grandage Ltd., of Bradford; **AJAX AJ8 Motorised Hand Milling Machines** are used extensively for accurate high speed machining. The **AJ8** is an essentially modern Hand Milling Machine designed expressly for machining rapidly and simply the wide range of small components incidental to the aircraft, automobile and general engineering industries.

### BRIEF SPECIFICATION

Spindle centre to top of table  
max. 6½ in.  
Spindle centre to underside of  
overarm 4½ in.  
Column face to overarm  
bracket 8½ in.  
Spindle nose to overarm  
bracket 8½ in.

### PEDESTAL MODEL

**£177**

**COMPLETE WITH  
4 SPEED SPINDLE  
AND ARBOR.**

**BENCH MODELS  
ALSO AVAILABLE.**

**WRITE TO AJAX TO-DAY FOR BROCHURE AND NAME OF NEAREST STOCKIST**

**AJAX MACHINE TOOL COMPANY LTD.**

**WEST MOUNT WORKS · HALIFAX · YORKSHIRE · ENGLAND**

Telephone: 5395/9

Telegrams: *Ajax, Halifax*

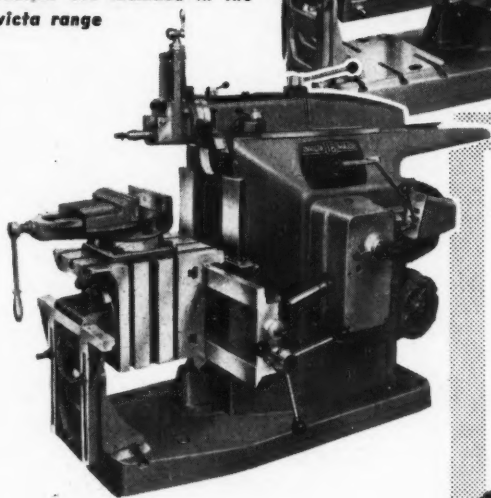
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# Built to last a lifetime

## ELLIOTT INVICTA

### MAJOR SERIES SHAPING MACHINES

18", 24" and 30" stroke  
machines are included in the  
Invicta range



- ★ 12 Cross Feeds
- ★ Auto trip prevents cross traverse overrun
- ★ Centralised controls
- ★ One shot lubrication

Available with plain, swivelling,  
universal and half tables  
(18" not available with half  
table)

Manufactured by

# B. ELLIOTT

(MACHINERY) LTD

(MEMBER of the B. ELLIOTT GROUP)

VICTORIA WORKS • WILLESDEN • LONDON • N.W.10

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Overseas Subsidiaries CANADA • U.S.A. • AUSTRALIA • S. AFRICA



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# THE CEMENT FOR INDUSTRY

**Because the same cement makes:—**

**Concrete in hours — not days**  
(using ordinary aggregate)

**Corrosion-resistant Concrete**  
(using ordinary inert aggregate)

**Refractory Concrete**  
(using refractory aggregate)

**Insulating Concrete**  
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**FOR SPEED • STRENGTH • RESISTANCE • REFRACTORINESS**

**LAFARGE ALUMINOUS CEMENT COMPANY LIMITED**

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# HYOP 80

*Hydraulically  
Operated*

## CO-ORDINATE JIG BORER

with  
**OPTICAL  
MEASURING**



### ALSO AVAILABLE

Model 120 having table traverses —  
longitudinal 45" — transverse 25"

★ Adjustment accuracy 0.00005"

★ Table hydraulically operated

★ Infinitely variable hydraulic feed  
to boring head

★ Table 48" x 30"

★ Spindle feeds infinitely variable  
5-1500 r.p.m.

★ Table traverses — longitudinal  
31½" — transverse 25"

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EXCLUSIVE DISTRIBUTORS IN THE UNITED KINGDOM

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MIDLANDS SHOWROOM: 1075 KINGSBURY ROAD, ERDINGTON, BIRMINGHAM 24. Tel: Castle Bromwich 3781/2  
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## **MOUNTFORD FORGINGS**

in carbon or alloy steel to B.S. Spec.,  
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**John Mountford & Co. Ltd.**

**MANCHESTER 11**

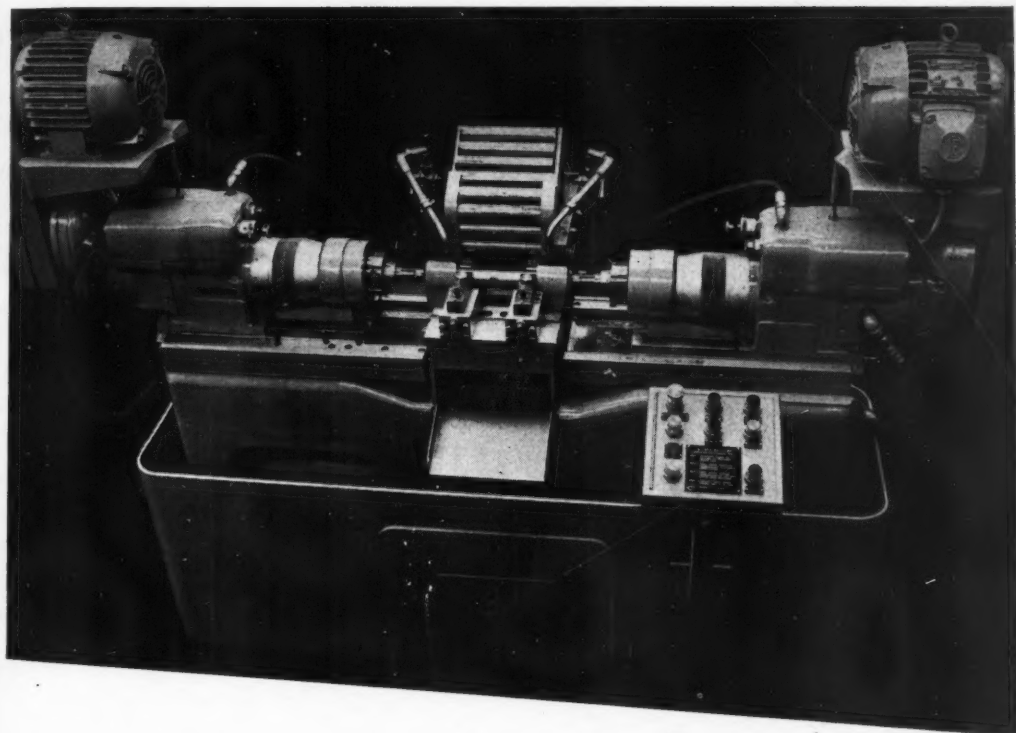
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*Write for illustrated brochures*



INCLUDED ON LLOYDS, ADMIRALTY AND MINISTRY OF SUPPLY LISTS

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**Just one more example of the** *Versatility*  
**of** **MARBAIX**

Two MODEL 19-400 MARBAIX AIR HYDRAULIC UNITS, arranged for full hydraulic operation, each with Overhead Pulley and Gear Reduction Drive, are used in this SPECIAL DOUBLE END SWAGING AND CHAMFERING MACHINE.

Tubes up to 9 $\frac{3}{4}$ " long by 18 S.W.G. are swaged each end for a length of  $\frac{1}{2}$ " in a cycle time of 9 seconds.

**THIS IS JUST ONE OF THE WIDE VARIETY OF USES TO WHICH THESE VERSATILE UNITS LEND THEMSELVES.**

**AIR  
HYDRAULIC  
DRILL  
UNITS**

*We will be pleased to forward details of this and other such applications on request.*

**MARBAIX INDUSTRIES LTD.**

VALIANT HOUSE, VICARAGE CRESCENT  
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# SPARK MACHINING PR ODUCES INTRICATE SH APES LIKE THIS-IN INT RACTABLE MATERIALS-E CONOMICALLY AND **FAST**

If you want to know more about the **GKN** spark machine write to our U.K. agents  
M. C. LAYTON LTD., ABBEY WHARF, MOUNT PLEASANT, ALPERTON, WEMBLEY, MIDDX · RUDKIN & RILEY LIMITED,  
CYPRUS ROAD, AYLESTONE, LEICESTER · ALFRED HERBERT LTD., P.O. BOX 18, RED LANE WORKS, COVENTRY  
MANUFACTURED BY WELSH METAL INDUSTRIES LTD., CAERPHILLY, GLAMORGANSHIRE



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# DRAWING DIES—

*New Machine gives MIRROR-FINISH  
faster than ever before!*

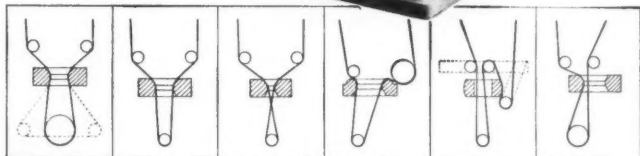


The **'BEER'**  
*Now British Built!*

## Only scientifically correct method of GRINDING & POLISHING DIES

Old Methods of DIE polishing leave small irregularities on the surface at right angles to draw, offering resistance to the flow of the material being drawn. The 'Beer' is designed to grind and polish in the direction of the draw, giving a superior surface in a fraction of the time taken by any other method. The machine is suitable for grinding before hardening and for grinding, lapping and polishing hardened steel and tungsten carbide dies.

*Suitable for DIES from  $\frac{5}{16}$ "  
—12" inside diameter and up  
to 19" outside diameter.*



How abrasive band can be adjusted to different sizes and shapes of dies.

**ROCKWELL**  
MACHINE TOOL CO. LTD.

WELSH HARP, EDGWARE ROAD, LONDON, N.W.2. TELEPHONE: GLADSTONE 0033

ALSO 'AT' BIRMINGHAM—TELEPHONE SPRINGFIELD 1134/5 • STOCKPORT—TELEPHONE STOCKPORT 5241 • GLASGOW—TELEPHONE MERRYLEE 2872

**Making the NEW**



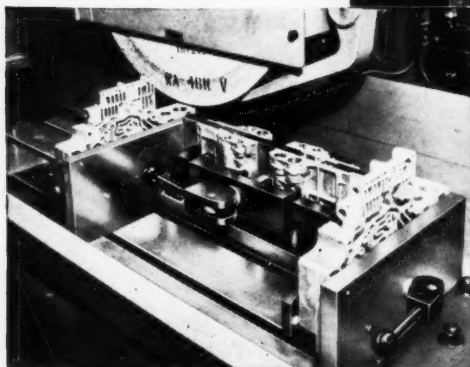
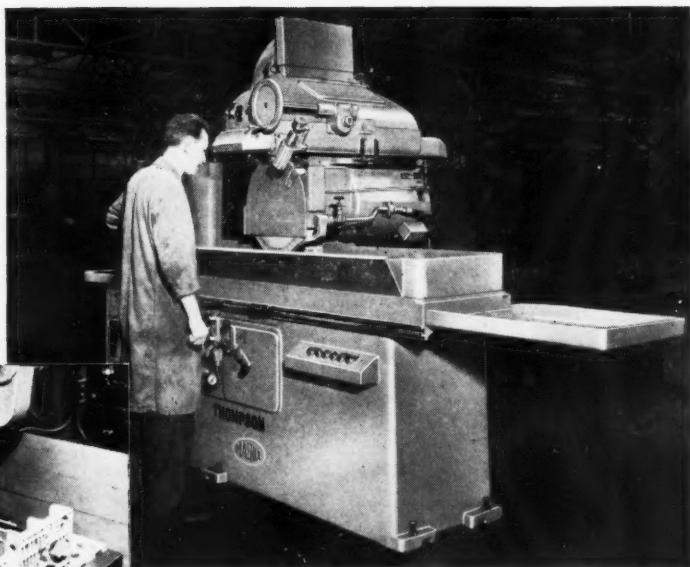
**Automatic 35 TRANSMISSION**



**BRITISH-BUILT**

# THOMPSON Surface Grinder

One of the many British-built Thompson Surface Grinders installed by leading manufacturers, this 16" x 12" x 40" Machine is grinding to close tolerances valve bodies for Borg-Warner Automatic Transmissions.



Built by Coventry Gauge and Tool Co. Ltd., Thompson Surface Grinders for plain or form grinding are available with table sizes from 8" x 24" to 36" x 240".

**ROCKWELL**  
MACHINE TOOL CO. LTD.

*For further particulars write or telephone TODAY*

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ALSO AT BIRMINGHAM—TEL: SPRINGFIELD 1134/5 • STOCKPORT—TEL: STOCKPORT 5241 • GLASGOW—TEL: MERRYLEE 2822

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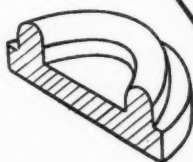
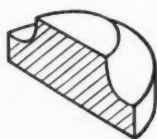
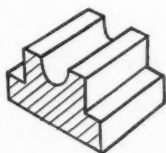
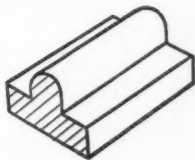
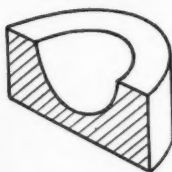
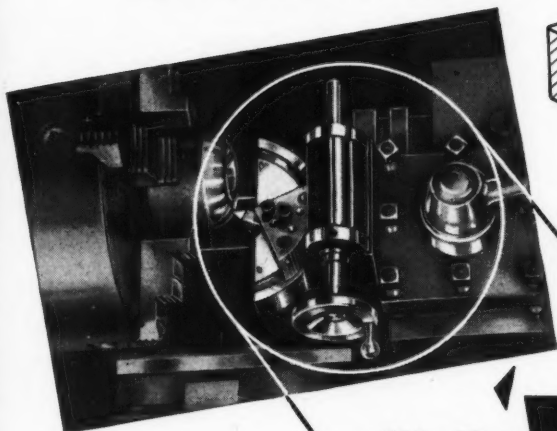
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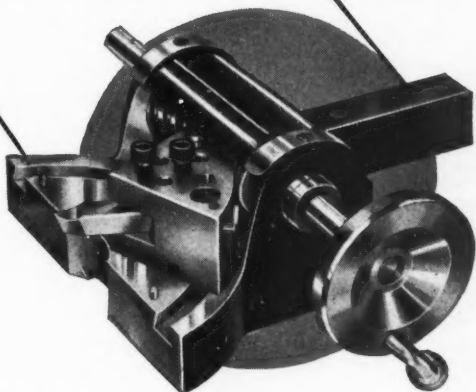


Adapt your Lathes and Shapers for

# SPHERICAL TURNING...



with the **HABIT**  
**TURN-A-ROUND**  
SPHERICAL TURNING ATTACHMENT



Accurate spherical turning and convex and concave radius forming on lathes and shapers is simplicity itself with the TURN-A-ROUND — another HABIT toolroom innovation. Clamp it in the toolpost — set it with the aid of a simple chart — and turn the handle. A full 90° radius can be produced in one setting, or with twin tool bits — 180° of arc can be covered. The HABIT TURN-A-ROUND is versatile, robust, needs no special skill and will prove to be a vital part of every toolroom's equipment and every turners' kit.

Write for technical literature

**HABIT GEOMETRIC TOOLING**  
LURGAN AVENUE : LONDON W.6  
TELEPHONE : FULHAM 7944

*Look for the Little Flag!*

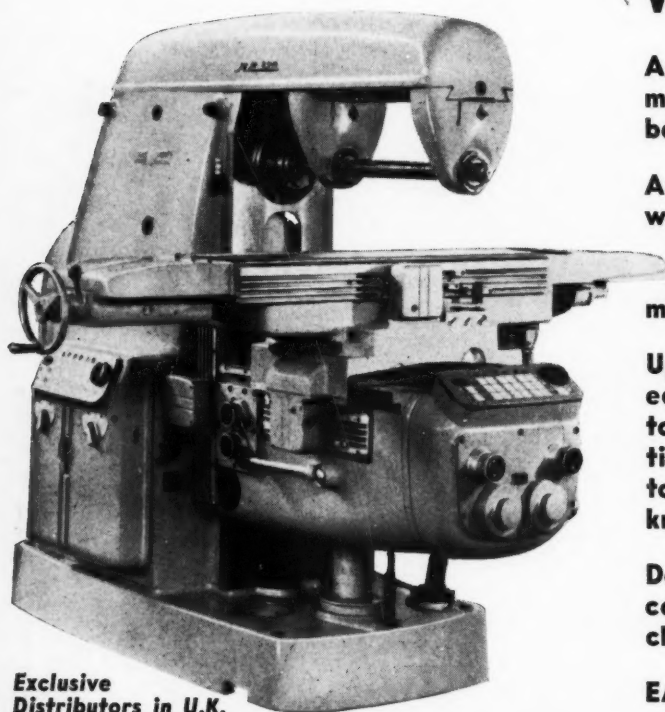
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## MODEL MUP 320

**SWITCH CONTROLLED  
ELECTRO - HYDRAULICALLY OPERATED  
MILLING MACHINES HORIZONTAL &  
VERTICAL**



**Exclusive  
Distributors in U.K.**

**As suitable for  
medium as large  
batch production.**

**Automation with  
working cycles  
variable in a  
matter of  
minutes.**

**Up to 60-70%  
economy in floor  
to floor milling  
times compared  
to conventional  
knee-type machines**

**Designed for  
conventional and  
climb milling.**

**EARLY DELIVERY**

# **TIMES**

**THE TIMES MACHINERY CO. LTD.**

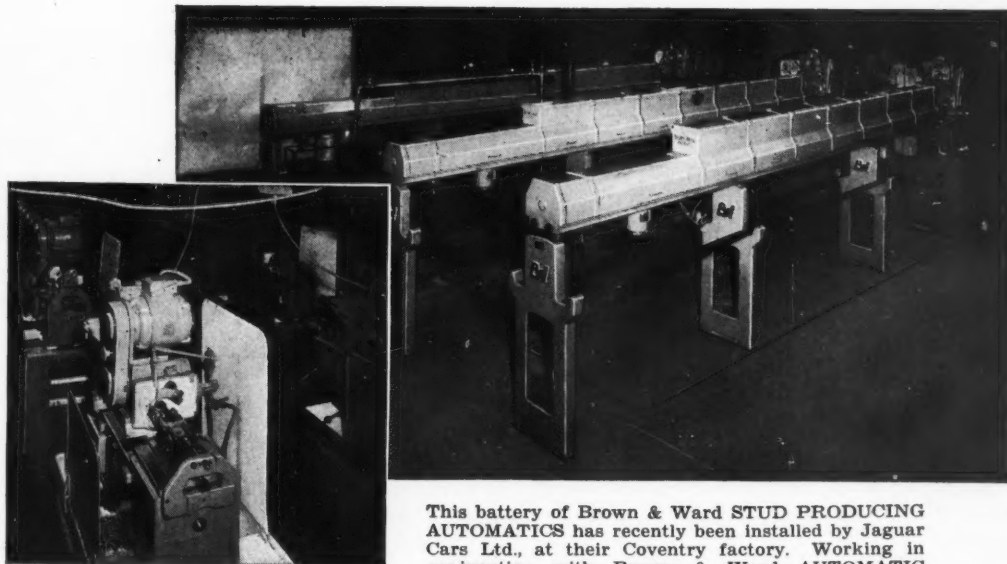
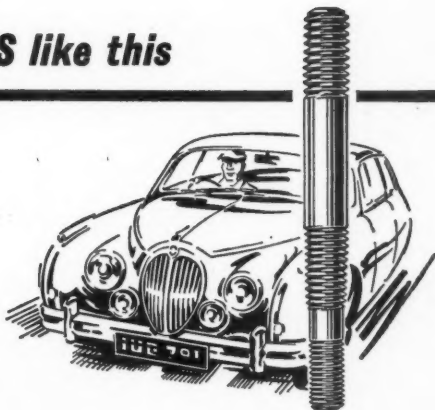
Poyle Road, Colnbrook, Slough, Bucks.

Telephone: Colnbrook 2442/3/4

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**To PRODUCE  
COMPONENTS like this**

**JAGUAR** cars  
choose  
**BROWN & WARD**



This battery of Brown & Ward **STUD PRODUCING AUTOMATICS** has recently been installed by Jaguar Cars Ltd., at their Coventry factory. Working in conjunction with Brown & Ward **AUTOMATIC MAGAZINE BAR FEEDS** these precision machines are producing components, like the threaded stud shown above, at maximum output and to the exacting standards required by Jaguars. The simplicity of these machines and equipment ensures reliability, and consequently a high productive efficiency, a fact which has been proved by the large numbers of machines installed in this and many other countries throughout the world.



Selling Agents in the U.K.: **ALFRED HERBERT LTD., COVENTRY.**

**Automatic Bar Machines and Magazine Bar Feeders**

**BROWN & WARD (TOOLS) LTD.**

Leamore Lane, Walsall.

Telephone Bloxwich 76846

W & W

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# MEDDINGS

*Pacera*

## For drilling machines plus complete tooling service



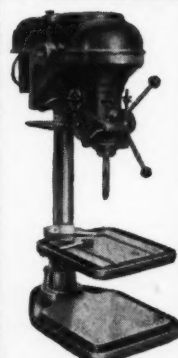
**DRILTRU**  
1/2" Capacity  
from £42



**LB. 1 MK II**  
1/2" Capacity  
from £56.15.0



**MB. 2 MK II**  
5/8" Capacity  
from £66



**MB. 4**  
7/8" Capacity  
from £91.10.0

Four very popular models are illustrated. We also make a full range of pedestal, multi-head, wall mounting and articulating head machines with throat depths up to 24".

### A COMPLETELY TOOLED SET-UP FOR *YOUR* PRODUCTION LINE

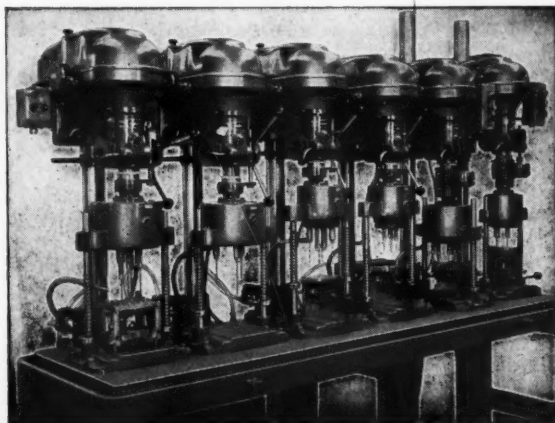
Have you investigated the possibility of using time-saving multi-spindle or multi-head methods on your components? We can supply anything from a simple 2-spindle attachment to a complete drill, ream, counterbore and tap sequence. Jigs and fixtures too, of course.

Write for full details to the Makers:

**W. J. MEDDINGS, LTD.**

IPSWICH ROAD, TRADING ESTATE, SLOUGH, BUCKS.

Tel: Slough 26761



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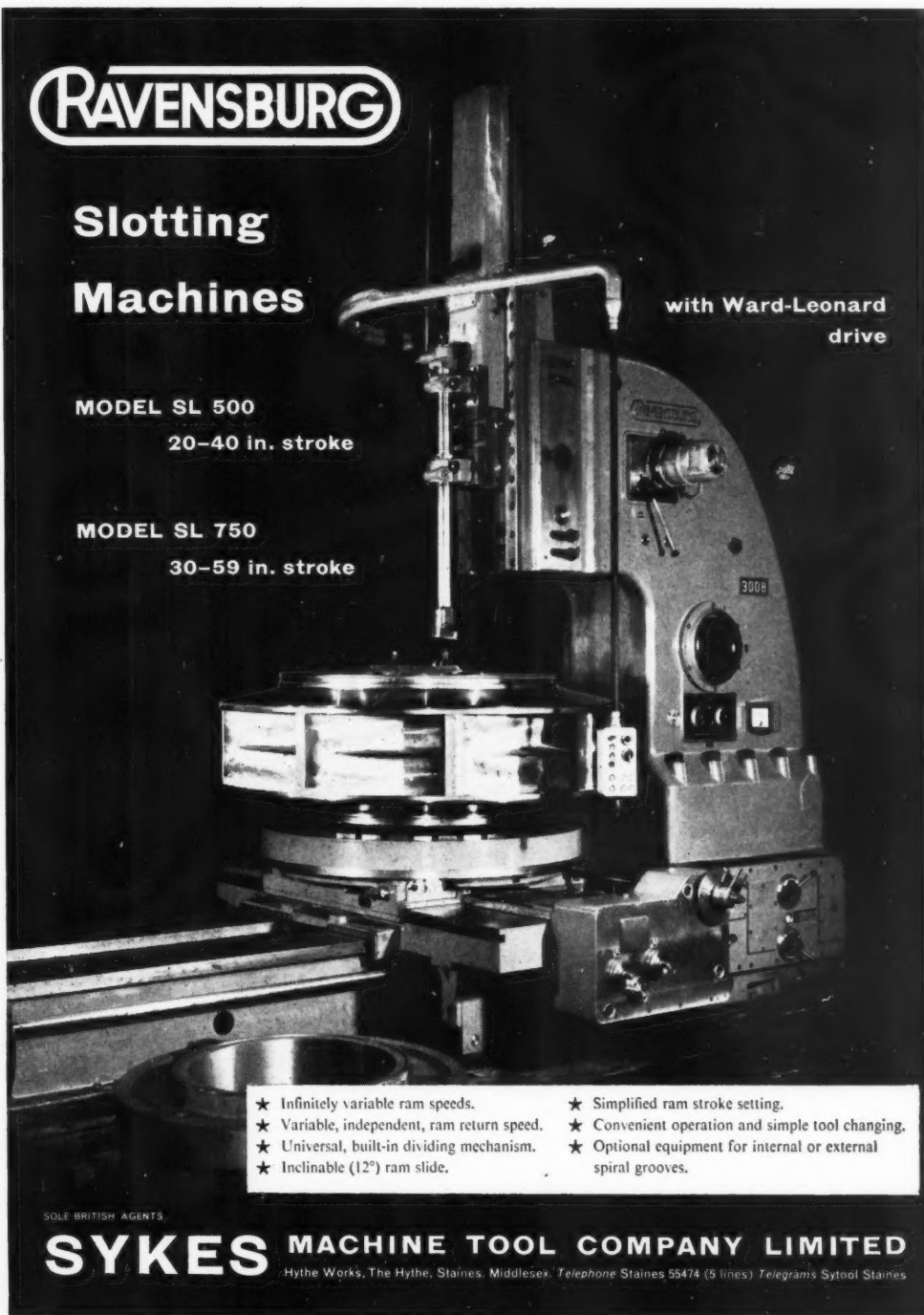
# RAVENSBURG

## Slotting Machines

with Ward-Leonard  
drive

**MODEL SL 500**  
20-40 in. stroke

**MODEL SL 750**  
30-59 in. stroke



- ★ Infinitely variable ram speeds.
- ★ Variable, independent, ram return speed.
- ★ Universal, built-in dividing mechanism.
- ★ Inclined (12°) ram slide.
- ★ Simplified ram stroke setting.
- ★ Convenient operation and simple tool changing.
- ★ Optional equipment for internal or external spiral grooves.

SOLE BRITISH AGENTS

**SYKES MACHINE TOOL COMPANY LIMITED**

Hythe Works, The Hythe, Staines, Middlesex. Telephone Staines 55474 (5 lines) Telegrams Sytool Staines

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# INDUSTRY WELCOMES THE NEW TECALEMIT RIBBON FILTER ELEMENTS

*Setting a fresh standard of high efficiency filtration for*

**AIR—WATER—PETROL | LUBRICATING, HYDRAULIC  
DIESEL AND FUEL OILS | AND OTHER FLUIDS**

## **Chosen for the famous FISHER Small Volume Regulators**

Tecalemit Ribbon Filter Element is used in the series 67 combination Filter Regulator, manufactured by Fisher Governor Company Limited of Rochester.

In such an application, the paper ribbon filter allows air to flow freely and provide adequate filtration, and water separation. A Tecalemit ribbon filter is sufficiently robust to withstand pressure drops well in excess of normal working conditions.



## **Tecalemit Ribbon Filter Elements**

**Simple construction—Low cost—High flow rate—Easy to clean**

The elements are formed to resin impregnated cellulose ribbon, wound helically and electrically fused into an open-ended cylinder. Innumerable microscopic orifices between the ribbons allow a very high flow rate, while retaining impurities on the outside or inside surfaces, according to direction of flow.

The standard range of diameters (in any length) covers most applications and no other filtration material can so readily be adapted to individual requirements for filters, strainers, breathers or separators. Never before has such fine filtration been possible at such low cost and with such flexibility in use.

*Tecalemit Ribbon Elements filter to maximum purity*

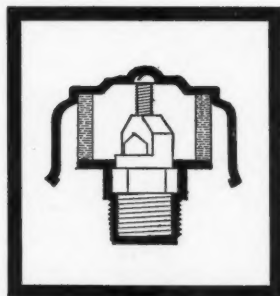
## **Tecalemit Air Breather Filters**

**(Incorporating Tecalemit Ribbon Filter Elements)**

Cheapest—most efficient—cleanest to service Tecalemit Breathers act as ventilators to provide a free flow of clean air to hydraulic fluid, fuel and oil reservoirs. They give positive protection from airborne contamination to tanks, pumps, valves, cylinder and other engine components.

Of the standard types, two are breathers with screwed bodies, and the third is a combined clip-on assembly of breather and filter cap. All are fitted with Tecalemit Ribbon Filter Elements.

*Tecalemit Breathers provide pure air cheaply and efficiently*



# TECALEMIT

the authority on filtration

TECALEMIT (ENGINEERING) LIMITED · (SALES M) · PLYMOUTH · DEVON

1733

*When answering advertisements kindly mention MACHINERY.*

## Besco Machines are good For Sheet Metal !



### For years and years,

**FJE** Besco machines have cut and shaped sheet metal for a variety of useful finished forms . . . from ducting to chick brooders; aircraft to refrigerators; ships to furniture . . . and still they cut and shape sheet metal.

**FJE** Besco guillotines and shears cut energetically and accurately through ferrous and non-ferrous sheets, press brakes, folders, angle benders and bending rollers form, bend and curve the panels, pans, boxes and mouldings.

**FJE** Besco swages and wiring machines bead and turn edges for ornamental strength and safety; nibbling machines precisely bite along the edges of intricately shaped templates.

**FJE** Besco flangers pound the edges of metal blanks and lift the edges high, square and even; presses pierce and stamp endless components in a flood of production.

Yes, indeed, Besco machines are good for sheet metal . . . without them, sheet metal would remain — well just sheet metal !

*Excellent terms:  
monthly account, hire purchase,  
or the F J E Machine Hire Plan*

## F. J. Edwards Ltd

EDWARDS HOUSE, 359-361 EUSTON ROAD, LONDON, NW.1.  
Phones: EUSton 5000 Telex 24264 Grams: Bescotools London NW1  
Lanedowns House, 41 Water Street, Birmingham, 3  
Phones: CENTral 7606/8 Grams: Bescotools Birmingham 3

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## THE MANAGER SAYS

*"Careful works costings  
have proved to my  
satisfaction that it  
pays to insist on the  
best Abrasive Cloth"*

**COATED ABRASIVE PRODUCTS  
FOR ALL METAL TRADES**

# OAKEY

**IN BELTS • DISCS • SHEETS & COILS**

**JOHN OAKEY & SONS LTD • WELLINGTON MILLS • LONDON S.E.1**



*When answering advertisements kindly mention MACHINERY.*

1961

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S







# DRUMMOND MAXICUT

## No. 2A Gear Shaping Machines



**Making the NEW**



**Automatic 35 TRANSMISSION**

These Maxicut Gear Shapers at Borg-Warner Limited are cutting 40 splines in front drums, 4 $\frac{1}{2}$  in. bore by 1 $\frac{1}{2}$  in. deep. Drummond Gear Shapers are widely used throughout the Motor Industry and can be arranged in link-lines for completely automatic production, if required.

**DRUMMOND BROS. LTD.**

GUILDFORD · ENGLAND  
Member of the Asquith Machine Tool Corporation

**DRUMMOND-ASQUITH LIMITED**

*Member of the Asquith Machine Tool Corporation*

KING EDWARD HOUSE, NEW ST., BIRMINGHAM Phone: Midland 3431. Also at LONDON Phone: Trafalgar 7224 & GLASGOW Phone: Central 0922

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# *Another* TWO-WAY DRILLING MACHINE

by **AMT**

*incorporating*

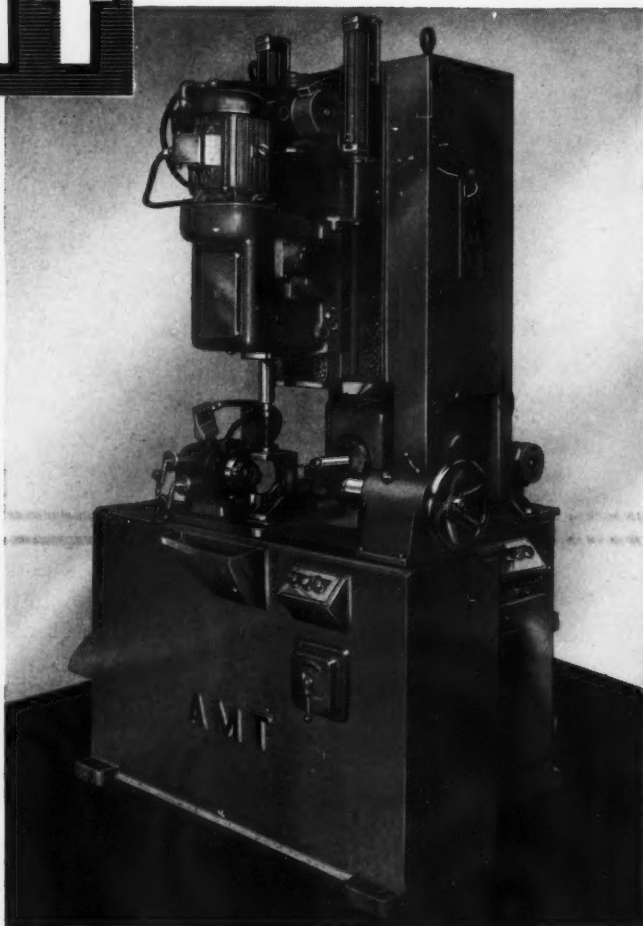
**2 AMT/DI**  
**2 h.p. UNIT HEADS**

Fully automatic  
cycle giving 10  
indexes, drilling  
20 holes.

Machine recently  
installed at  
**THE BRITISH PISTON RING**  
**CO. LTD., COVENTRY** by  
whose kind permission  
this photograph  
is reproduced.

*Operation:*

20- $\frac{13}{16}$ " dia. holes  
Cycle time 2 $\frac{1}{2}$  minutes.



The range of AMT Drilling Heads comprises four sizes from 2 to 20 h.p. Brochure and full specifications will gladly be supplied on application.

**A·M·T (B'HAM) LTD.** BOURNBROOK, BIRMINGHAM 29  
*Telephone: SELly Oak 1128/9/20. Telegrams: AMTOLD B'ham*

*When answering advertisements kindly mention MACHINERY.*







# Where Efficiency Counts



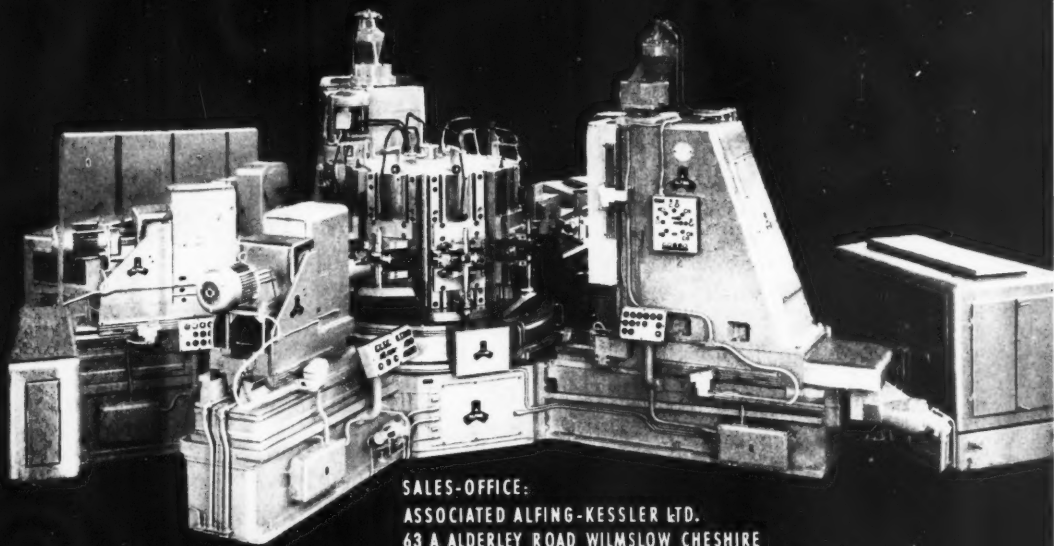
## AUTOMATIC MACHINING

of balance-weight seats on 22 different types of crankshafts.

- Station 1: loading
- 2: rough milling
- 3: drilling
- 4: probing
- 5: finish milling
- 6: counter boring and reaming
- 7: rough tapping
- 8: finish tapping
- 1: unloading

Floor to floor time of component as shown: 3.2 mins.

All units hydraulically operated by lead screw and infinitely variable hydraulic motor.



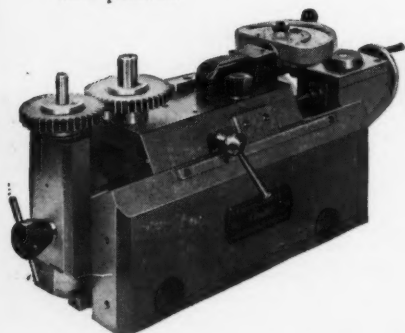
SALES-OFFICE:  
ASSOCIATED ALFING-KESSLER LTD.  
63 A ALDERLEY ROAD WILMSLOW CHESHIRE  
Telephone: Wilmslow 5344/5/6 Telex: Butler Wilmslow 66475

ALFING-KESSLER-WERKE · WASSERALFINGEN/WUERTT. GERMANY

# Goulder

## GEAR MEASURING EQUIPMENT

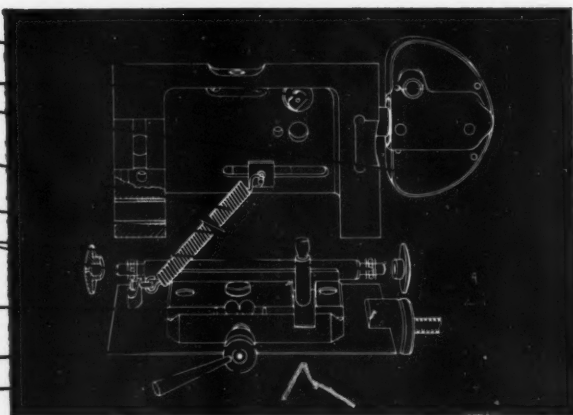
*This series of advertisements is intended to show how attention to detail design backed by careful and precise manufacture has made Goulder gear measuring equipment first choice of buyers who appreciate these qualities.*



### ROLLING TESTER SADDLE ASSEMBLY

used on Goulder No. 1 Rolling Tester to measure variations in centre distance as two gears are rolled together under spring pressure and hence composite gear errors. Special layout of saddles allowing 1, vertical adjustment for gear under test 2, extra sensitivity 3, reduced bed length.

- CAM ACTION CENTRALISING LOCK TO PROVIDE DATUM
- FLOATING SADDLE IN NITRALLOY STEEL
- MICRO-INDICATOR AS ALTERNATIVE TO ELECTRONIC RECORDER
- SPRING TO PROVIDE ADJUSTABLE MEASURING PRESSURE
- STYLUS ABUTMENT PEG
- REAR BEARINGS CONSISTING OF TWO RINGS OF BALLS CARRIED ON A HARD STEEL SHAFT IN A HARD STEEL BUSH
- FRONT BEARINGS CONSISTING OF TWO BALLS CARRIED IN HARD VEE AND FLAT BEARINGS
- SLIDING SADDLE IN HARDENED NITRALLOY STEEL
- CAM ACTION LOCK FOR CENTRE DISTANCE SETTING



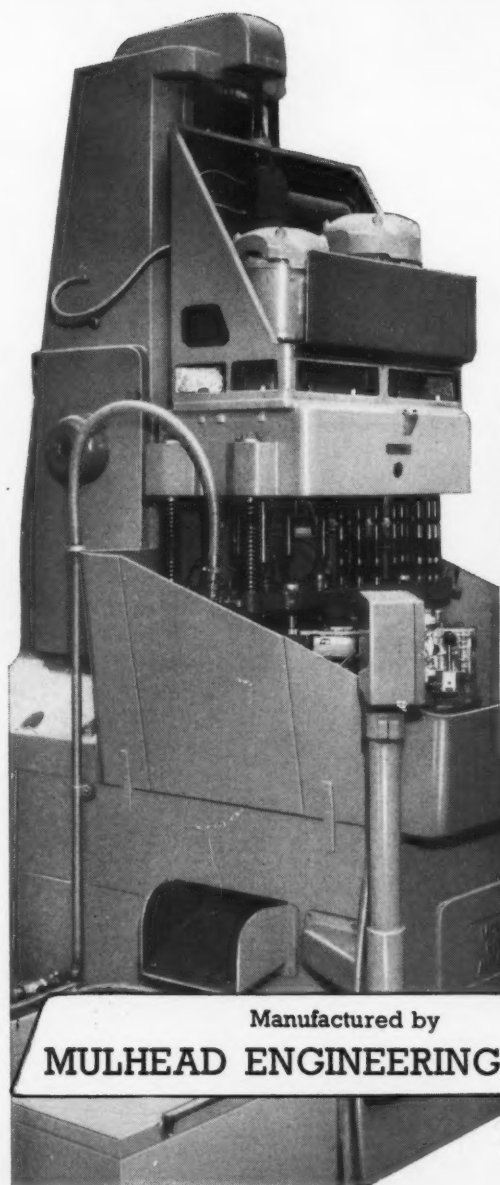
# Goulder

## THE NAME FOR ALL GEAR TESTING

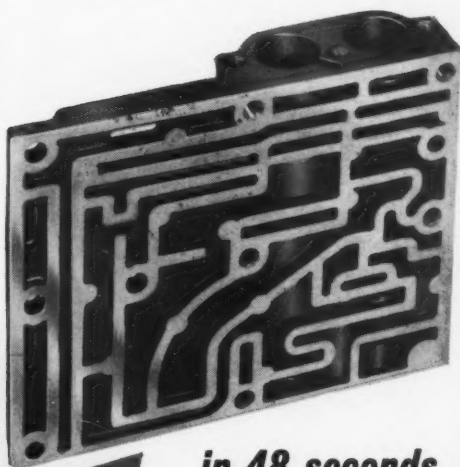
J. Goulder & Sons Ltd., KIRKHEATON, HUDDERSFIELD. Tel: Huddersfield 5252-3

JS17

When answering advertisements kindly mention MACHINERY.

**Making the NEW****BW****Automatic 35 TRANSMISSION**

Upper valve body drilled and tapped in three planes as follows: one hole No. 26 drilled and countersunk, one hole  $\frac{1}{8}$ " diameter drilled in two stages  $1\frac{1}{8}$ " deep, three holes  $\frac{1}{8}$ " diameter drilled to maximum depth of  $1\frac{3}{32}$ ", twelve holes tapped 10-24 N.C.—2B.



**in 48 seconds  
on a MULHEAD  
ROTARY AUTOMATIC**

An excellent example of  
versatility that can solve  
many production problems

Manufactured by  
**MULHEAD ENGINEERING Co. Ltd.**

SOLE SELLING AGENTS:

**Ryder**

Thomas Ryder & Son Ltd.  
Turner Bridge Works,  
BOLTON, ENGLAND.

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# ABWOOD

## UNIVERSAL MACHINE VICES AND COMPOUND ANGLE TABLES FOR ALL ACCURATE WORK

Suitable for jig boring, grinding, milling and shaping machines. Movements are fully indexed through  $360^\circ$  in the horizontal plane and  $90^\circ$  in the vertical. Any combination of angles can be obtained.



Available with 4" and 6" jaw widths. Accurately indexed for angular work with spot sight and knife edge for register. Note the clean design, low height and rigid mounting. Angles cannot alter once the clamps have been locked.



Universal table fitted with interchangeable table. Changeover from circular to rectangular table is readily effected by loosening clamping bolts.

Available in two sizes. Circular 6" and 8" diameter. Rectangular 8" x 6" and 10" x 8".



ABWOOD MACHINE TOOLS LTD., PRINCES ROAD, DARTFORD, KENT

Telephone : Dartford 25271 (5 lines)

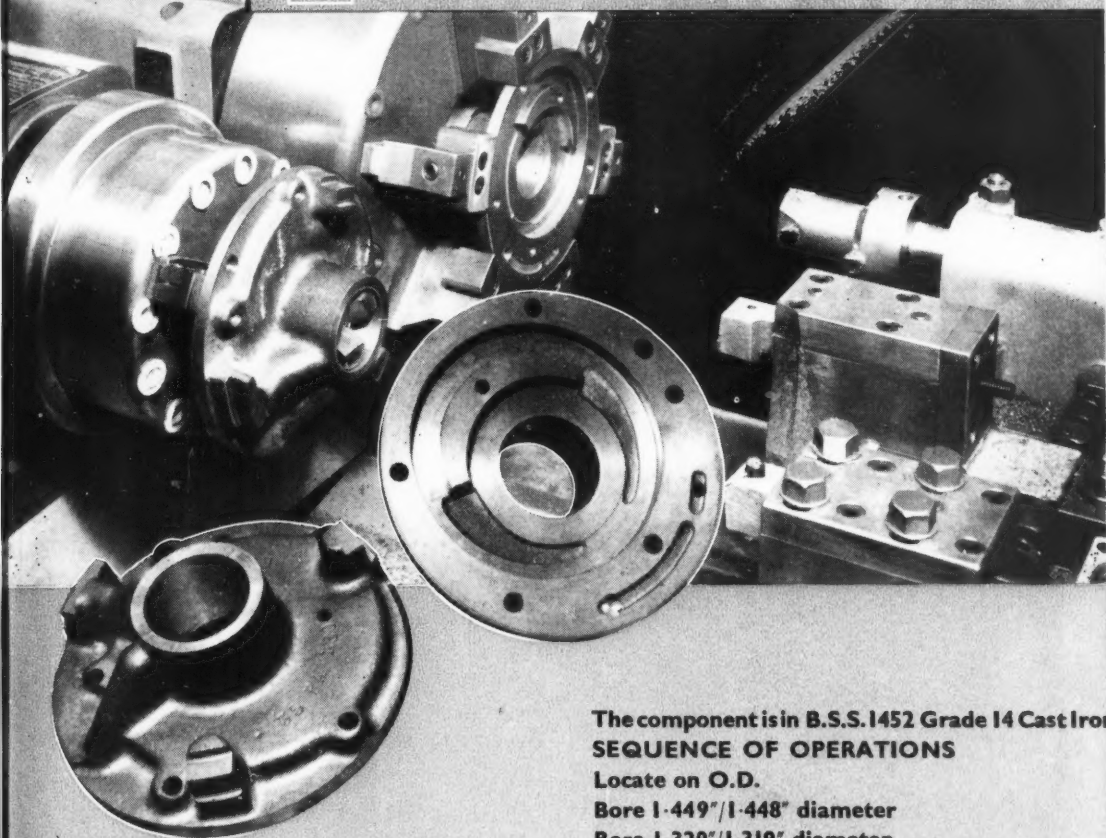
Telegrams : ABWOOD DARTFORD



61  
(Supp) 65  
**Making the NEW**



**Automatic 35 TRANSMISSION**



The component is in B.S.S.1452 Grade 14 Cast Iron  
**SEQUENCE OF OPERATIONS**

Locate on O.D.

Bore 1.449"/1.448" diameter

Bore 1.320"/1.319" diameter

Chamfer 20°x.142" / .137"

Locate on Bore

Turn 5.249"/5.247" diameter

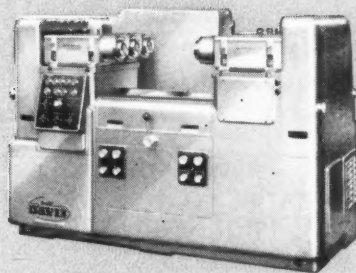
Plunge Face 1.736"/1.734" diameter

**TIME CYCLE at 300 ft/min. MEAN 67 SECOND!**

The Rear Pump Body of the Borg Warner Automatic 35 Transmission being machined on one of several STUART DAVIS Fine Borers supplied to the Manufacturers for these operations

**FINE BORERS by**

*Stuart*  
**DAVIS**  
LTD

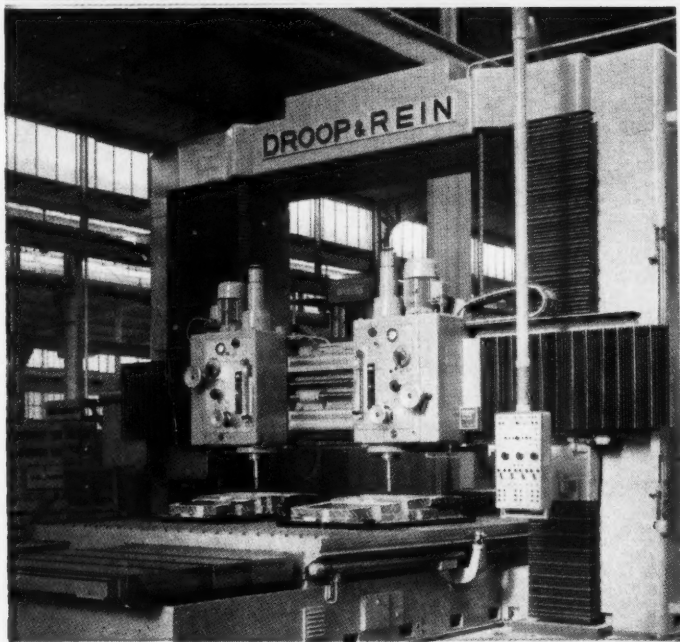


STUART DAVIS LTD., STONEBRIDGE HIGHWAY, WILLENHALL, COVENTRY Tel: Toll Bar 2451/



# ROTAX BALL SCREWS SPECIFIED BY DROOP & REIN

THE MOST ADVANCED RECIRCULATING BALL THREADS USED IN INDUSTRY



This Droop and Rein double planomilling machine is probably one of the largest in the world and Rotax ball screws are incorporated to move the cross-rail which weighs over 20 tons. Rotax ball screws meet this demand with an efficiency of over 90% and have great resistance to wear. Made of special stabilised materials they give longer life, greater accuracy and reduce maintenance costs.

Rotax Ball Screws are used wherever a highly efficient transfer of rotary to linear movement, or vice versa, is required. An impressive range of shaft lengths from 2 inches to 25 feet is available with a variety of pitch circle diameters and leads to suit your particular need.

Rotax Designers and Engineers are available to assist with your problems on a world-wide basis.

PLEASE WRITE OR TELEPHONE — THE COMMERCIAL MANAGER, PRECISION PRODUCTS

## ROTAX

**ROTAX LTD.**

MAYLANDS AVENUE, HEMEL HEMPSTEAD, HERTS. (Tel. BOXMOOR 4444)

LUCAS-ROTAX (AUSTRALIA) PTY., LTD., Melbourne and Sydney, Australia.  
LUCAS-ROTAX LTD., Toronto, Montreal and Vancouver, Canada.





**Making the NEW****Automatic 35 TRANSMISSION**

# UNIVERSAL DIAGONAL GEAR SHAVING

All of the significant improvements and refinements in gear shaving practice for the past 30 years are incorporated in the Red Ring Universal Diagonal Gear Shaving Machine, Model GCU, to make it the most versatile and effective unit of its kind ever built.

In accordance with Red Ring practice, the cutter head which is a relatively small unit is located above the work. Head and tailstocks together with the tables comprise a much heavier unit located below the work and always under compression whether at rest or under load. After being set, the cutter head is clamped while the tables have running clearance.

This arrangement also provides two additional advantages. If the work gear is accidentally dropped when being loaded, it cannot damage the cutter. With the cutter above the work chips readily fall away from it.

Gears may be shaved by either the conventional or diagonal method on the Red Ring Model



G.C.U. Gear teeth may be shaved straight, crowned, tapered or to conical form. When crowned, the position and amount of crown may be located along the tooth as required. Wide or narrow face gears, open or close shoulder gears, plunge hobbled gears or gears with long shafts can be shaved on the Red Ring Model G.C.U.

Loading and unloading may be manual, semi-automatic or fully automatic.

We are proud to announce the fact that Red Ring Model G.C.U. Semi and Fully Automatic Gear Shaving Machines similar to the one illustrated are in use at the Borg-Warner, Letchworth, factory



PUR AND HELICAL GEAR SPECIALISTS  
ORIGINATORS OF ROTARY SHAVING,  
GEAR HONING AND ELLIPTOID

**PRECISION GEAR MACHINES & TOOLS LIMITED**

(An Associate Company of National Broach & Machine Co., Detroit, U.S.A.)  
"World's Largest Producer of Gear Shaving Equipment"

**RED RING WORKS, BODMIN ROAD, COVENTRY**

Telephone: Walsgrave-on-Sowe 2372 Telegrams: Pregearmac, Coventry

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— **Making the NEW** —



**Automatic 35 TRANSMISSION**

**Churchill**

**MODEL H.B.A.  
AUTOMATIC SIZING  
INTERNAL  
GRINDER**

.... one of the many  
Churchill High Precision  
Grinding Machines in  
the 'Borg-Warner'  
Plant .....

Engaged on finishing the bore and  
internal face of front wheel clutch  
cylinders this model H.B.A. automa-  
tic internal grinder is depend-able for  
the rapid production of close limit  
work.

There are CHURCHILL high preci-  
sion grinders to cover every need.  
Details of a machine for your own  
work will gladly be sent on request.



A Member of the B.S.A. Group of Companies

**THE CHURCHILL MACHINE TOOL CO. LTD**

**BROADHEATH**

HOME SELLING AGENTS  
**CHARLES CHURCHILL & CO. LTD**  
BIRMINGHAM and BRANCHES



**MANCHESTER**

EXPORT SALES ORGANISATION  
ASSOCIATED BRITISH  
MACHINE TOOL MAKERS LTD  
LONDON, BRANCHES and AGENTS



— **Making the NEW** —



**Automatic 35 TRANSMISSION**



### **SPLINE GAUGES**

As specialists we offer a complete advisory, design and manufacturing service for spline quality control



## **PERFECTION ENGINEERING**

**LIMITED**

**MANUFACTURERS OF FORM GROUND GAUGES AND TOOLS  
STATION ROAD, COLESHILL, BIRMINGHAM**

*Tel. Colehill 3351 (5 lines)*

European Agents: Technisch Handelsbureau R. Meininger, Laan Van Meerdervoort 91, Den Haag, Holland,  
Lundwall & Co. A.B., V. Hamngatan 5, Gothenburg 1, Sweden  
Fenwick, 15, Rue Fenelon, Paris 10, France

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**Making the NEW**

October 4, 1961



# *Automatic* **35** TRANSMISSION



ABOVE: Rear servo bodies, aluminium alloy, are bored on two diameters, chamfered, back faced and the cir-clip groove formed at one setting on the versatile Model 2112.

AT RIGHT: Valentry covers, malleable iron, are shown set-up two at once. Operations include boring, facing, chamfering and grooving. Fine finishes to close limits are obtained.

The EX-CELL-O range includes single or double-ended machines with number of heads to meet requirements. All machines have the following outstanding features.

1. LOWER COST
2. INCREASED FLEXIBILITY
3. GREATEST VERSATILITY
4. GREATER CAPACITY

Ask for a representative to call.

**EX-CELL-O FOR PRECISION**

AGENT: Ex-Cell-O Group Sales Ltd

Hatford House, Charles Street, Leicester

Telephone: Leicester 26734

Telegrams: GROUPEX, Leicester

**EX-CELL-O CORPORATION**

(ENGLAND) LTD.

HASTINGS ROAD, LEICESTER

**Making the NEW** October 4, 1961

MACHINERY

page 71



**Automatic 35 TRANSMISSION**



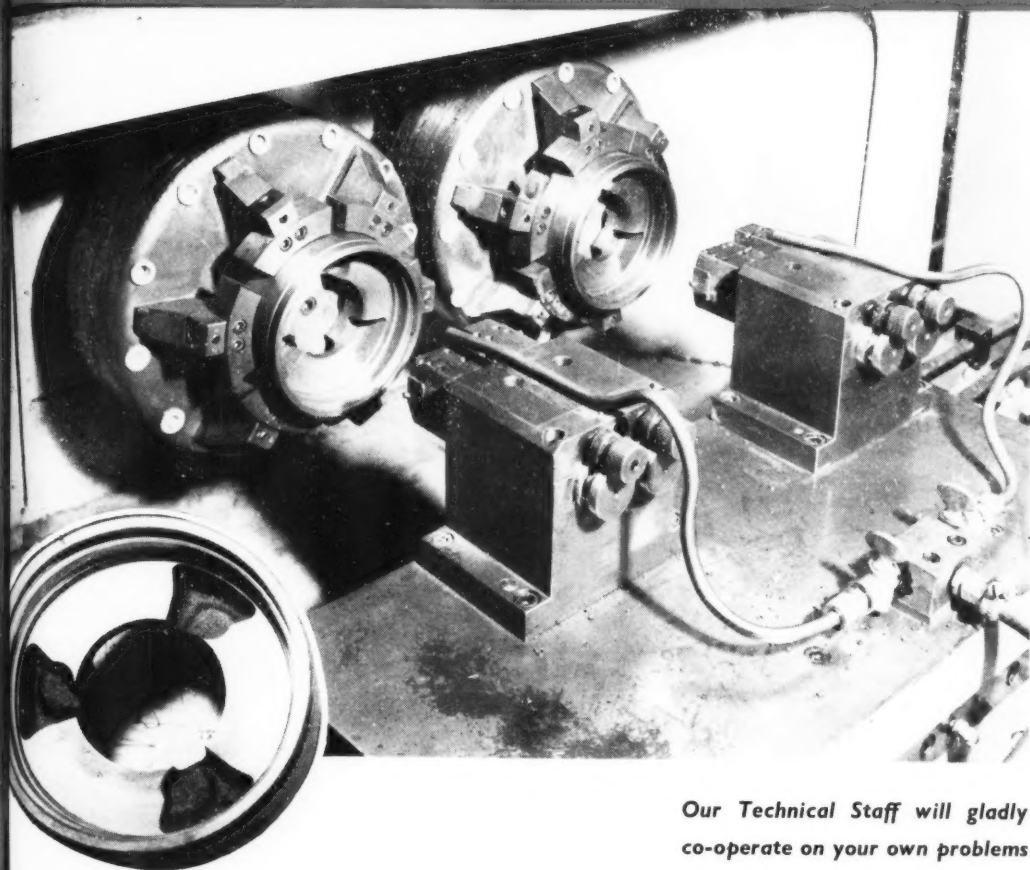
**EX-CELL-O STYLE 2112**

**PRECISION BORING MACHINE**

**FAST-VERSATILE**

**BORING, FACING, CHAMFERING AND GROOVING**

**at BORG-WARNER, LTD., LETCHWORTH**



**Our Technical Staff will gladly  
co-operate on your own problems**

**EX-CELL-O FOR PRECISION**

Ex-Cell-O Groun Sales Ltd  
Halford House, Charles Street, Leicester  
Telephone: Leicester 26791  
Telegram: GROUNDPEX, Leicester

**EX-CELL-O CORPORATION**  
(ENGLAND) LTD. HASTINGS ROAD, LEICESTER

**Making the NEW**



**Automatic 35 TRANSMISSION**

# TEST RIGS *and* DYNAMOMETERS



We are proud to have designed and built the following Electro Hydraulic Test Rigs used to ensure the consistently high quality of the new Borg-Warner '35' Transmission

- Test Rig for Governor
- Test Rig for Front and Rear Pump
- Test Rig for Front and Rear Clutch

We have also re-designed and re-built the Dynamometers for the testing of the complete Transmission.

## PLUNGE WASHERS

The Plunge Washers installed throughout the Borg-Warner Factory were also built by us.

### TOOLING ASSEMBLY OR TEST EQUIPMENT

We specialise in the design and production of Electro Hydraulic or Pneumatic tooling, assembly or Test equipment to meet any Production or Test Problem and would welcome any enquiries.

## HYDRO-PNEUMATICS LIMITED

PRIORY ROAD • HARDWAY • GOSPORT • HANTS  
TELEPHONE: GOSPORT 60371-3



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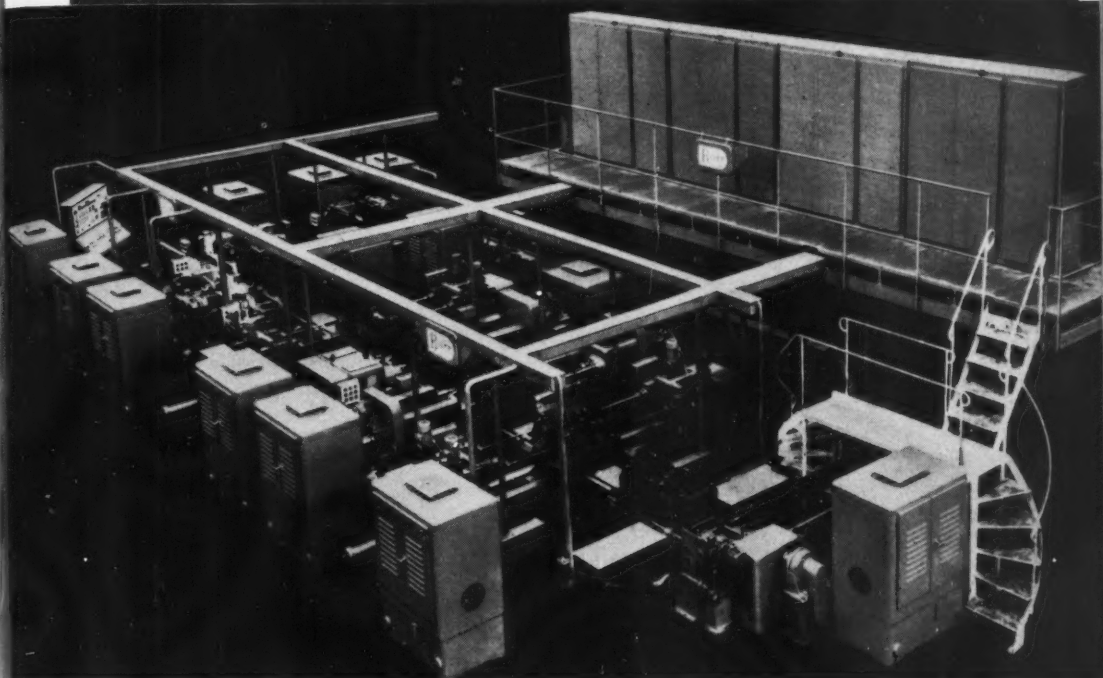


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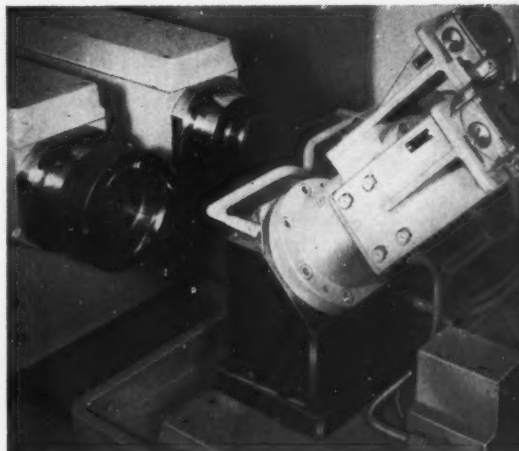
**Making the NEW**



# *Automatic* **35** TRANSMISSION



Three Burr transfer machines, drill, ream, tap, mill and finebore the complete Borg Warner transmission case. The rate of work — 800 parts in only 16 hours.



Burr fine borers are ideal for components demanding high accuracy at economic production rates.



**LUDWIGSBURGER MASCHINENBAU GMBH**

Sole Agents for Great Britain and Northern Ireland

**GEO. KINGSBURY & CO. (MACHINE TOOLS) LTD**

54, Victoria Street, London, S.W.1. Telephone: TATe Gallery 0462

Showroom and Spares Dept:

46, Milner Street, London, S.W.2

Telephone: KNIlebridge 8402



**Making the NEW****Automatic 35 TRANSMISSION****Automatically  
LAPOINTE  
for surface broaching**

Built for 'one operator' control, simple to operate and exceptionally easy to maintain, Lapointe surface broachers are essentially light on manpower. Push button controls, automatic lubrication and other typically Lapointe features make these machines the best value in their class.

**come to LAPOINTE for better broaching**

The Lapointe Machine Tool Co Ltd

Otterspool Watford By-Pass Watford Herts  
Watford 31711 (4 lines) Cables Lapointe Watford

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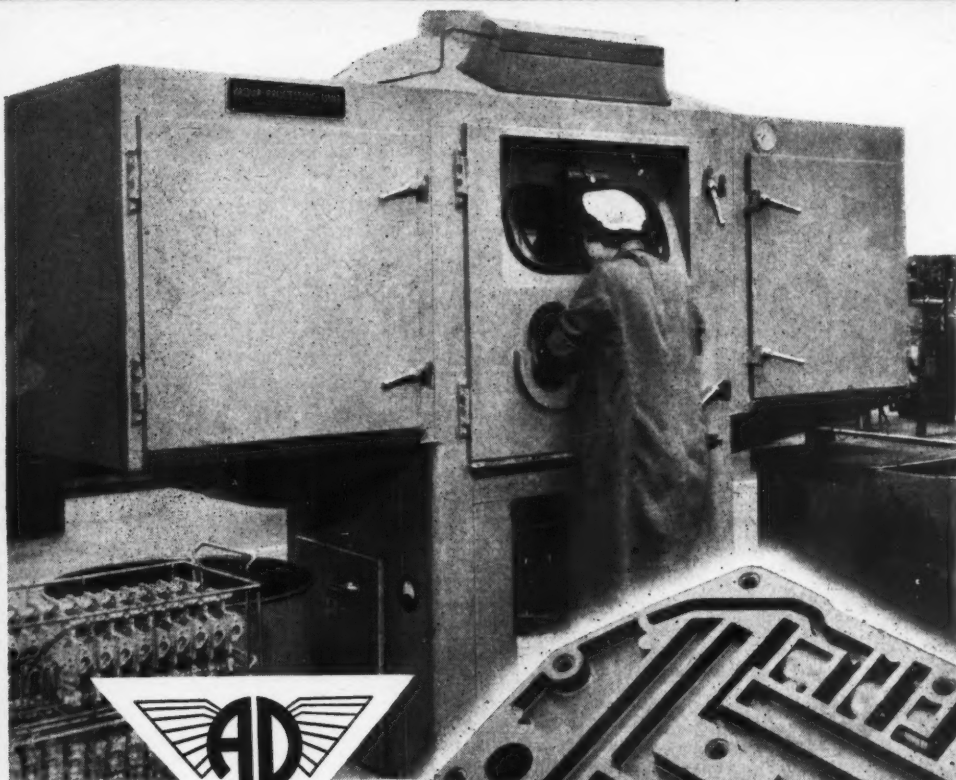




**Making the NEW**



**Automatic 35 TRANSMISSION**



## VAQUA PROCESSING UNITS

**DE-BURR, CLEAN AND POLISH  
WITHOUT DIMENSIONAL CHANGE**

This VAQUA processing unit has been installed at Borg-Warner Ltd., for the deburring of fraze after machining, cleaning all loose particles out of components and super finishing many parts which are assembled into the new Automatic '35' Transmission.

The VAQUA process is the ideal pre-treatment for plating and painting. Units are available to meet most requirements and our technical staff will gladly co-operate on your own problems.

## ABRASIVE DEVELOPMENTS LTD.

**HENLEY - IN - ARDEN • SOLIHULL • WARWICKSHIRE**

Phone: HENLEY-IN-ARDEN 43518 (4 Lines) Grams: AUTOFLOW, Henley-in-Arden  
Sales & Demonstration Dept. 49 High Street  
Head Office & Works 17/19 High Street

**OVERSEAS AGENTS THROUGHOUT THE WORLD**

*When answering advertisements kindly mention MACHINERY.*

**Making the NEW****Automatic 35 TRANSMISSION**

## SHOTBLAST PLANT

*for the rapid  
abrasive cleaning of  
a wide variety of  
components*

At Borg-Warner Ltd., as in many other famous factories, SPENSTEAD shot blast plant has proved highly efficient and economical for the cleaning of finished components after heat treatment.

We build shot blast plants in a variety of models for the cleaning and surface finishing of machined components or raw castings. Complete details will be sent on request.

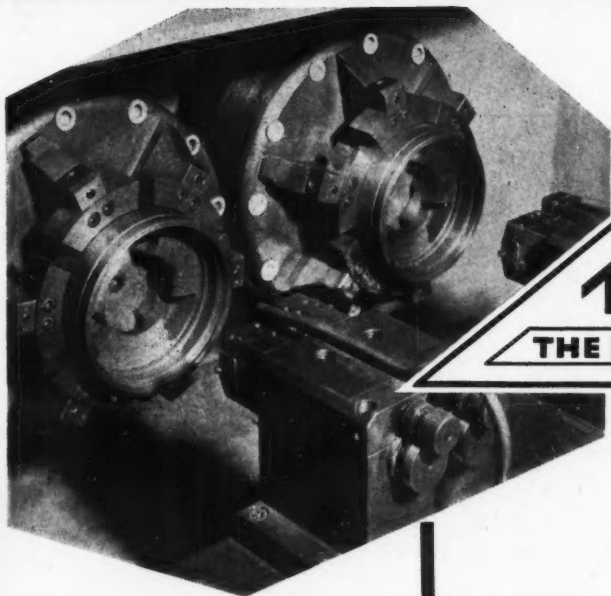


**SPENCER & HALSTEAD LTD.**  
BLAST CLEANING DIVISION  
OSSETT, Yorks.

Powney/550

When answering advertisements kindly mention MACHINERY.



**Making the NEW****Automatic 35 TRANSMISSION**
**THE MASTER METAL****TUNGSTEN  
CARBIDE  
TIPS & TOOLS**

*... used for machining many components at Borg-Warner Ltd., Letchworth*

'TECO' tungsten carbide is made throughout in our London factory from the basic metal carbides to the final shaping and lapping. Over the years since 1934, various grades have been developed, each of which we are confident will give superior performance on the material for which it has been designed. Our Technical Staff is always available for consultation on your own metal cutting problems. Get in touch with us.

*For those who like history—*

The production of TECO in this country commenced in 1934, and was made possible by the wealth of experiences and technical data—passed on by C. A. Laise of The Teco Corporation of America. Laise, one of the pioneers in the production of metal carbides, took out patents describing the cementation of tungsten as early as 1917, almost ten years before the introduction of the first commercially produced hard metal.

**'TECO' The Master Metal**

Made and proved on production in Great Britain since 1934

*'TECO' quality is unsurpassed—delivery of standard tips and tools unequalled*

*Write to-day for catalogue*

*—Pioneers in Tungsten Carbide for over a third of a century—*

**R · G · McLEOD TOOLS LTD · LAVINA GROVE · LONDON · N·1**

TELEPHONE: TERminus 6066

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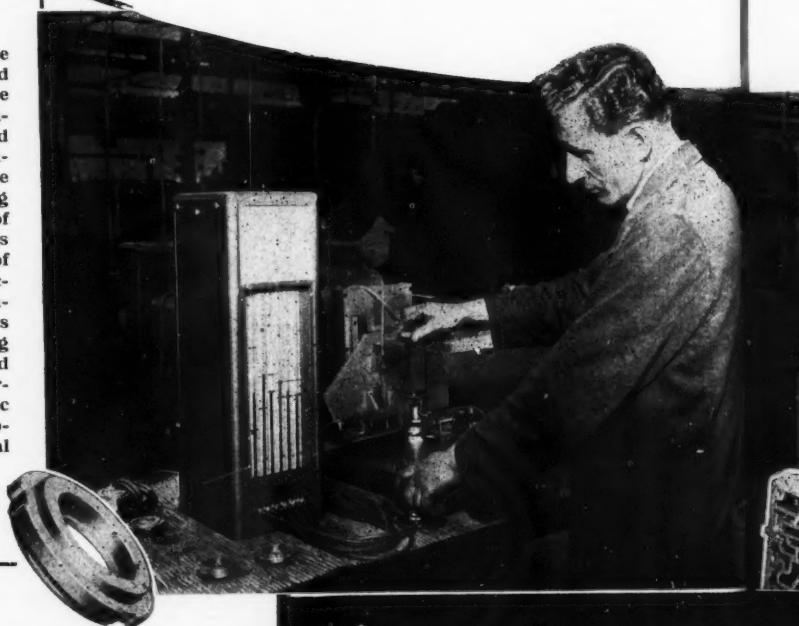
**Making the NEW**



**Automatic 35 TRANSMISSION**

**We are proud  
to announce...**

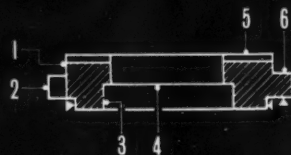
The design and manufacture of inspection equipment used at Borg Warner Ltd. is the result of the close co-operation between the design and planning staffs of both Companies. Knowing their precise requirements and applying our specialised knowledge of gauge design and techniques has resulted in equipment of the right type for each inspection function. May we recommend that you invite us to examine your gauging problems and thereby extend to you a comprehensive service in mechanical, pneumatic and electric gauging equipment to suit your special needs.



**VERNON**

**INSTRUMENT Co. Ltd.**

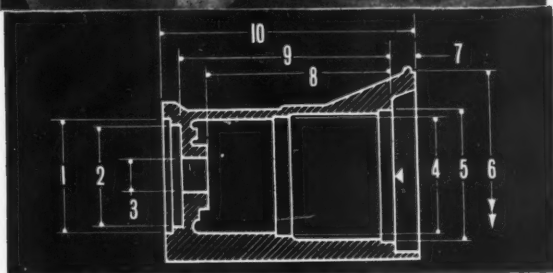
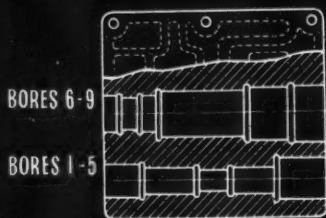
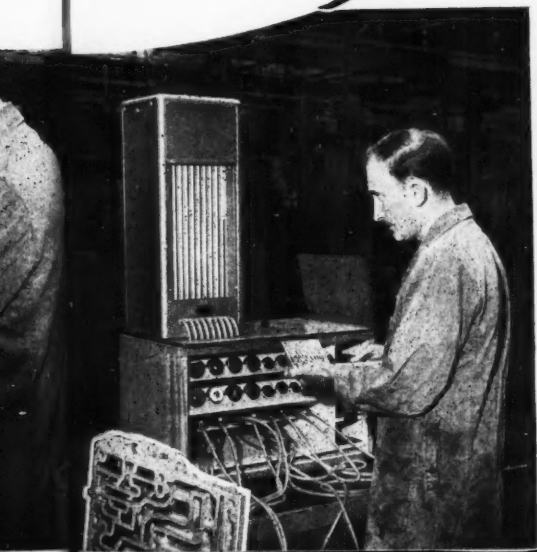
HITCHIN • HERTS • ENGLAND



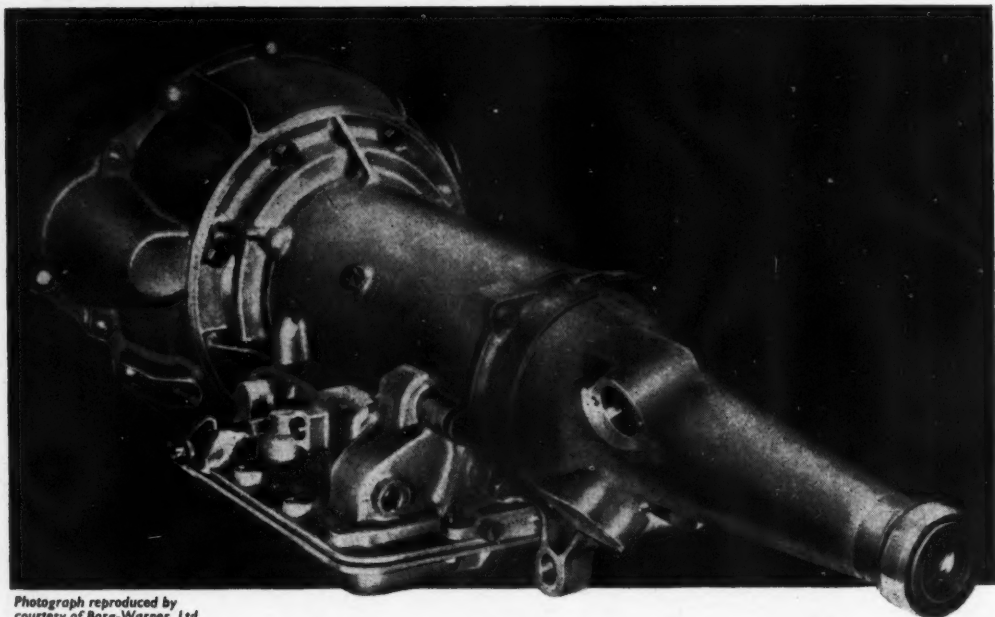
*When answering advertisements kindly mention MACHINERY.*

... that the majority of the special multi-dimensional air-operated gauges and gauging fixtures for the BORG-WARNER AUTOMATIC '35' TRANSMISSION were designed and built by

**VERNON**



*When answering advertisements kindly mention MACHINERY.*

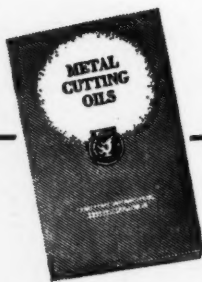


Photograph reproduced by  
courtesy of Borg-Warner, Ltd.

The Metal-Working Oils and Lubricants — in considerable variety — used in the production of the **Borg-Warner new Automatic Transmission Model 35**, are the exclusive products of Edgar Vaughan & Co. Ltd., the Oil Specialists.

## **EDGAR VAUGHAN BORG-WARNER**

*Contributors to better motoring*



A brochure giving an outline of the immense variety of metal cutting oils and lubricants manufactured by Edgar Vaughan is available against requests on your business heading.

# *Edgar* **Vaughan** E Co. Ltd.

**LEGG STREET · BIRMINGHAM 4**

Works and Depots at: Birmingham, London (Southall)  
Manchester, Liverpool, Bristol, Glasgow.



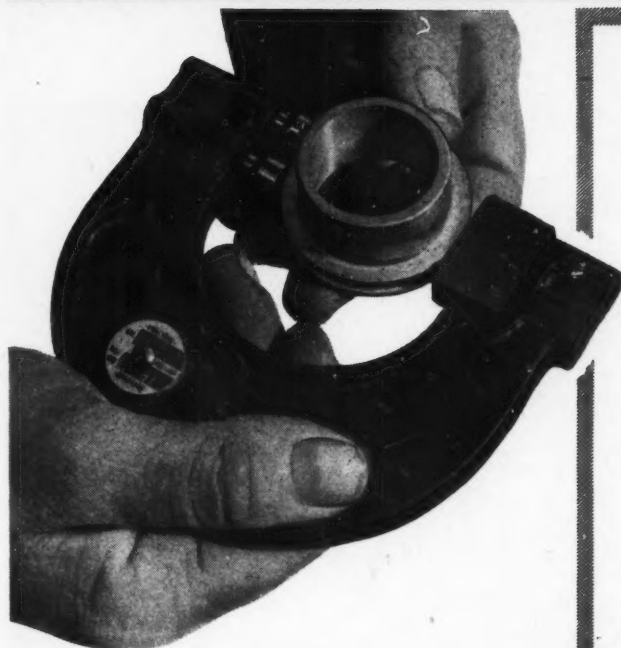
In Association with the Houghton group of Companies all over the world.

*When answering advertisements kindly mention MACHINERY.*

# **Making the NEW**

**BW**

## *Automatic 35* TRANSMISSION



**BORG-WARNER say:**

**“Yorkshire  
—precisely”**

**YORKSHIRE PRECISION GAUGES LIMITED**  
HATFIELD, Near DONCASTER, YORKSHIRE

Tel.: Hatfield, Woodhouse 303 • Grams: Precision, Doncaster

**Y P G**

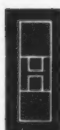
### **ADJUSTABLE PLAIN CALIPER GAUGES & PLUG GAUGES are in use through- out this fine plant**

Large numbers of Y. P. G. adjustable caliper gauges are in use in this fine plant for the checking on the production line, as well as on inspection, of numerous components for the new Automatic '35' Transmission.

These gauges are available in four types with anvils of hardened steel lapped flat and parallel.



**TYPE E\***  
Knife edge  
adjustable  
anvils for  
undercuts,  
etc. Range  
0-1 1/2 in. dia.



**TYPE A**  
Four-pin  
headless  
adjustable  
anvils.  
Range 0-  
3/16 in. dia.

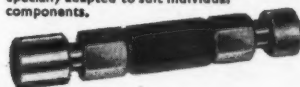


**TYPE G**  
Two-pin  
headed  
adjustable  
anvils and  
fixed block  
anvil. Range  
0-1 1/2 in. dia.  
As illustra-  
ted above.



**TYPE B**  
Four-pin  
headed  
adjustable  
anvils.  
Range  
0-1 1/2 in.  
dia.

\* Borg-Warner use these extensively. Many were specially adapted to suit individual components.



**PLUG GAUGES TOO . . .**  
supplied by us, are widely used in the BORG-WARNER plant. They are available with anodised aluminium handles colour coded red/green. Their superior surface finish ensures long life coupled with accuracy. Price list on request.

When answering advertisements kindly mention MACHINERY.



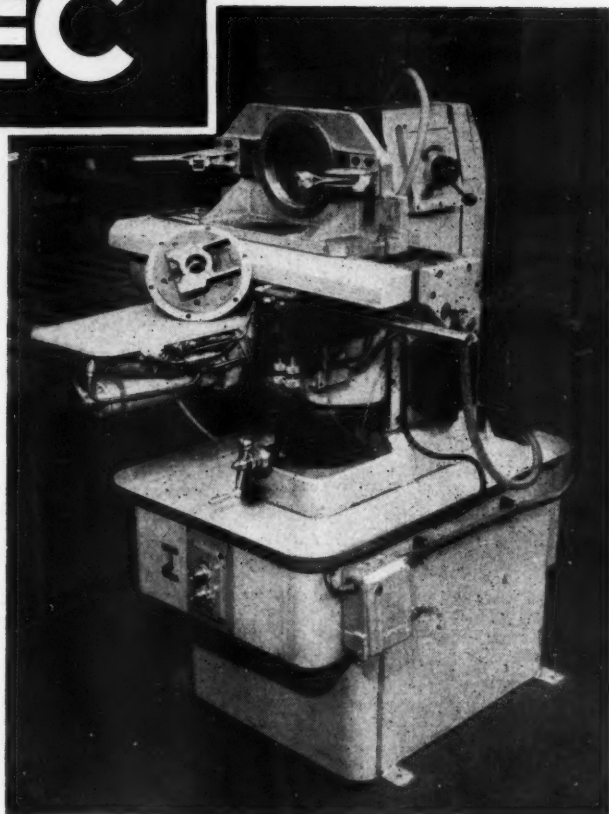
**Making the NEW****Automatic 35 TRANSMISSION****CENTEC****AUTOMIL****FOR MILLING  
IN  
AUTOMATIC  
CYCLES**

- ★ **HYDRO-PNEUMATIC  
TABLE DRIVE**
- ★ **12in. TABLE TRAVERSE**

Our photograph shows the CENTEC 'AUTOMIL' at Borg-Warner Ltd., Letchworth.

This machine with hydro-pneumatic drive gives automatic production cycles consisting of very fast approach of 1200in. per minute, followed by pre-set, hydraulic, infinitely variable feed.

For automatic production, the machine can be set for work in cycles consisting of fast approach, pre-set cutting feed and automatic fast return.



**Also available with Vertical  
swivelling head for MILLING  
& DRILLING all angles**

**MAIN DIMENSIONS**

Table traverse	12in.	Cross Traverse	5½in.
Table size	5in. by 25in.	Feeds stepless up to max.	
Fast approach	1200in. per min.		400in. per min.
Fast return	420in. per min.	Spindle motor	1 h.p.
Spindle Centre to Table	7½in.	With well-known accessories: ●Pneumatic Index Tables ●Rotary Tables ●Dividing Head, etc.	
(can be increased by insertion block)			
Vertical Traverse	7½in.		

**CENTEC MACHINE TOOLS LTD****CENTEC WORKS • HEMEL HEMPSTEAD • HERTS**

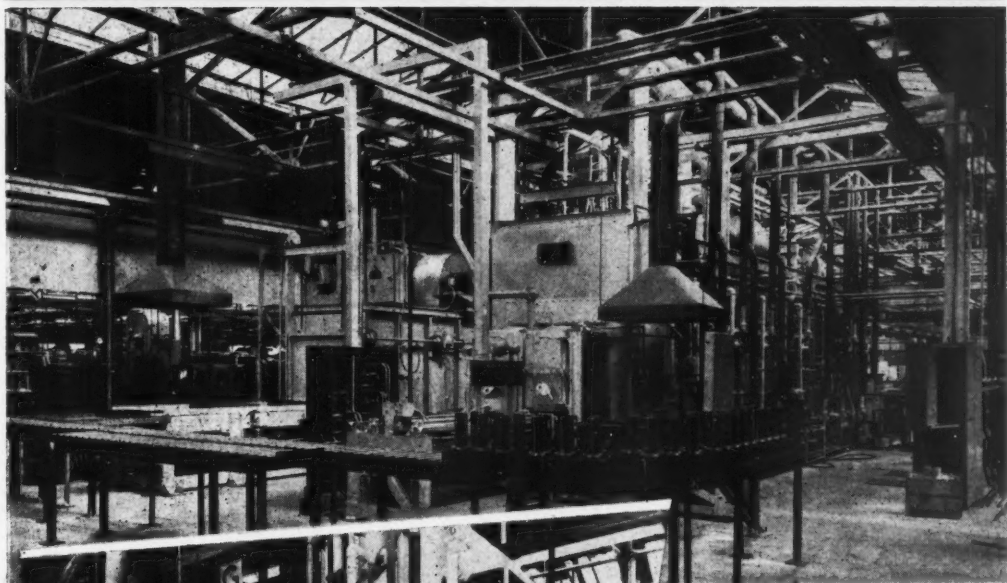
Phone: BOXMOOR 584-5-6

*When answering advertisements kindly mention MACHINERY.*

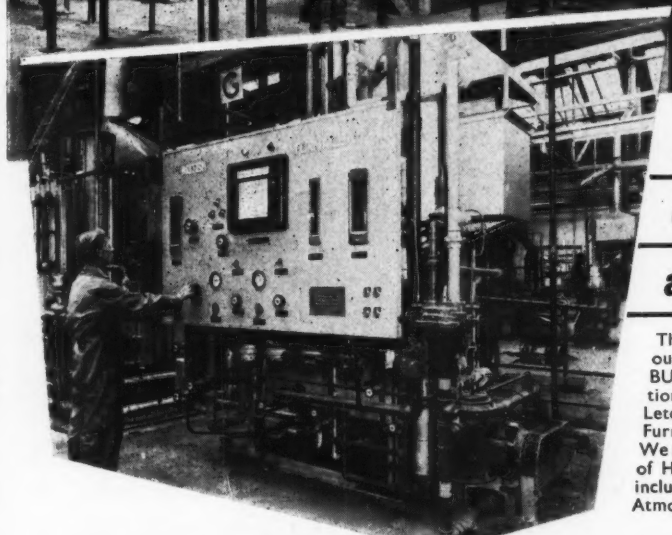
**Making the NEW**



**Automatic 35 TRANSMISSION**



**continuous  
carburising  
and tempering**



The Furnaces illustrated were designed by our American Associates, SURFACE COMBUSTION, Division of Midland Ross Corporation, and installed at Borg-Warner Limited, Letchworth, and are identical with similar Furnaces which we build in this country. We are specialists in the design and construction of Heat Treatment Furnaces for all purposes, including fully automatic continuous plants, Atmosphere Generator Units, etc.

**BRITISH  FURNACES LTD**

Associated with:  
SURFACE COMBUSTION, DIVISION OF MIDLAND ROSS, TOLEDO, U.S.A. and the BRYAN DONKIN COMPANY LTD., CHESTERFIELD, ENGLAND.

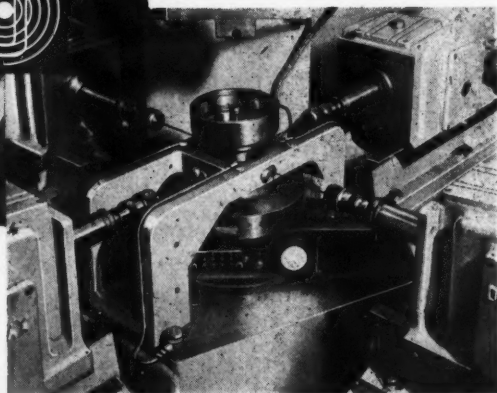
**DERBY ROAD, CHESTERFIELD, ENG.**  
TELEPHONE: CHESTERFIELD 3153 (6 LINES)

When answering advertisements kindly mention MACHINERY.

**Making the NEW****Automatic 35 TRANSMISSION**

Drillmax Machine illustrated is one of the several now in operation at the new £4,000,000 extension to the Borg-Warner Automotive Transmission factory at Letchworth, Herts.

Five-way (two station Rotary Index) Drilling Machine for drilling two  $\frac{5}{16}$  in. diameter holes and eight  $\frac{3}{32}$  in. diameter holes in cast iron Front Clutch Cylinders.



Indexing tables are standard Drillmax equipment and can be supplied in conjunction with our range of standard Unit-Head and Multi-Head equipment.

**PETER BRASSHOUSE LTD**

**BIRMINGHAM  
AND ALDRIDGE**

**DRILLMAX DIVISION, LEIGHWOOD ROAD, ALDRIDGE, STAFFS.**

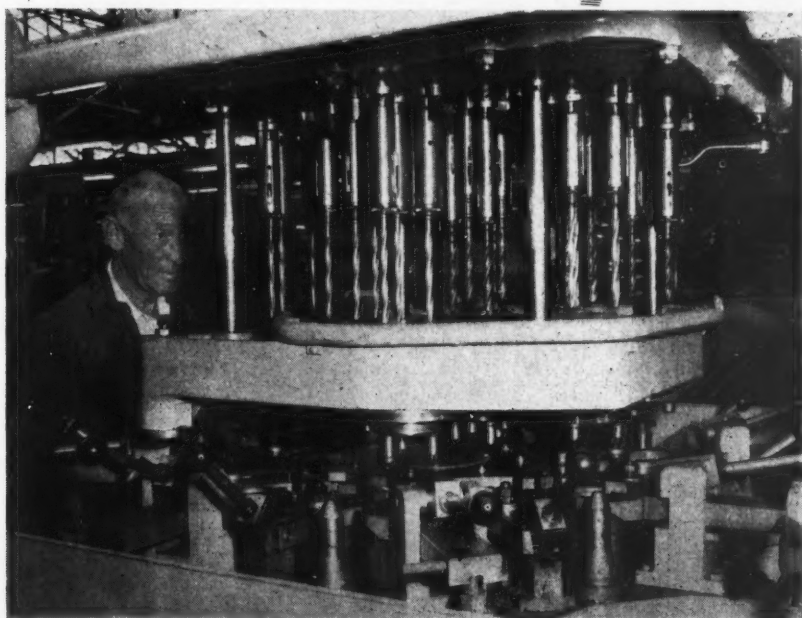
Telephone: Aldridge 52814 and 52815, and at Spring Hill, Birmingham.

Telephone: EDGbaston 2114-5

*When answering advertisements kindly mention MACHINERY.*

**Making the NEW****Automatic 35 TRANSMISSION****CLEVELAND****CLE-FORGE***fine tools...for fine products*

An example of TEAMWORK TOOLING — a term we have adopted to best describe our basic approach to cost reduction in customer's factories. It represents the combined talents and efforts of many people serving the best interests of the metal working industries.

**CLEVELAND TWIST DRILL (G.B.) LTD.**

SALES DIVISION: STRATFORD ROAD · SHIRLEY · BIRMINGHAM

Telephone: SHirley 4551/2 Cables: CLEFORGE, SHIRLEY Telex 33-378

HEAD OFFICE AND WORKS: PETERHEAD ABERDEENSHIRE



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**Making the NEW**



**Automatic 35 TRANSMISSION**



## SHAFT HARDENING MACHINES

*... ensure rapid and uniform results at low cost*

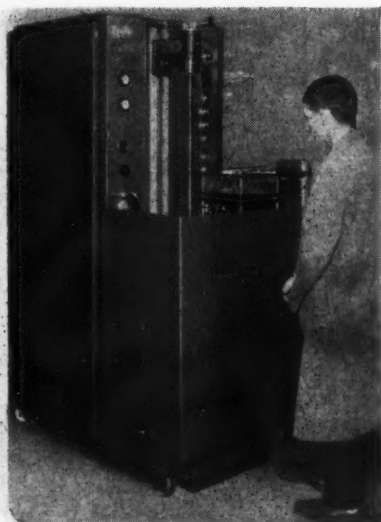
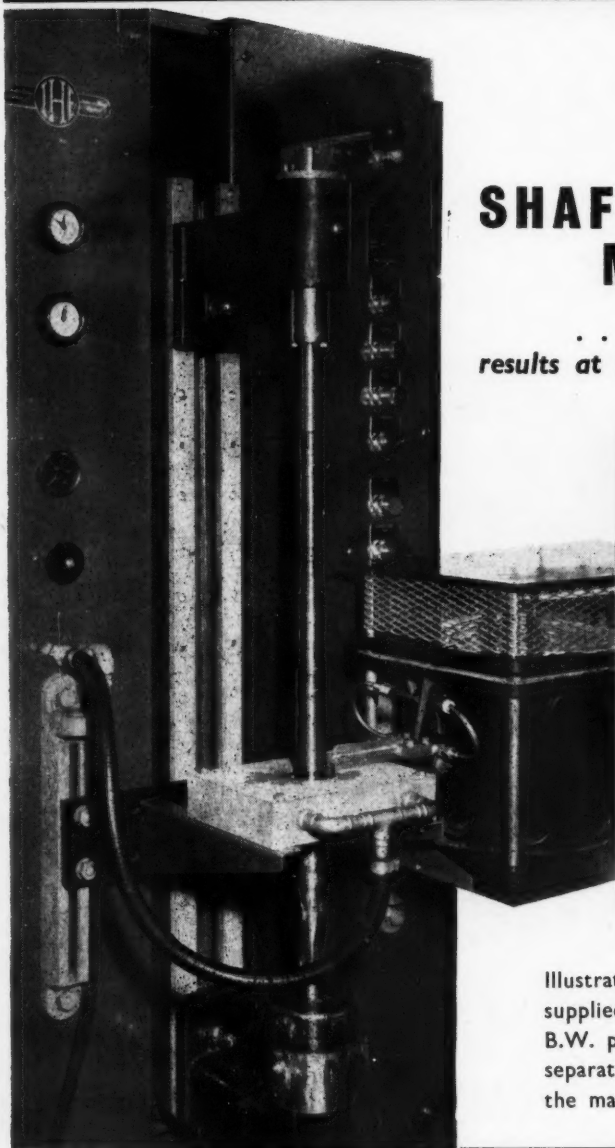


Illustration shows one of several machines supplied for induction hardening for the B.W. project. This machine treats five separate zones of differing diameters in the main shaft in one operation.

### INDUCTION HEATING EQUIPMENT LTD.

11 MOLESEY ROAD • HERSHAM • WALTON-ON-THAMES • SURREY  
TELEPHONE: WALTON-ON-THAMES 23173

*When answering advertisements kindly mention MACHINERY.*



**Making the NEW**



**Automatic 35 TRANSMISSION**

**"EXACT BALANCE —  
OR CONTROLLED UNBALANCE"**

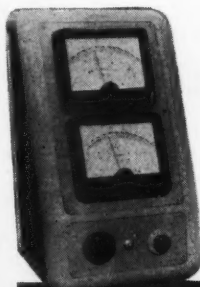
**JACKSON-BRADWELL**

**STATIC BALANCING  
MACHINES**

**ensure both these factors**

**at BORG-WARNER LTD., LETCHWORTH**

Model SVO/IE static balancing machine, correcting unbalance on planet carriers. Amount and position of unbalance is automatically indicated and surplus metal removed by the built-in drill.



◀ This Model SVO/E machine is used to ensure **ACCURATE PREDETERMINED UNBALANCE** on governors so that when a valve is subsequently fitted the balance of the assembly is restored.

There are JACKSON-BRADWELL machines for every duty to handle components and assemblies from the smallest to the largest sizes. There is a machine well suited to your own needs. Ask us for details.

**JACKSON & BRADWELL LIMITED.,** Grove House, Sutton New Road, Birmingham 23

Telephone: ERDington 7411/2

Telegrams: Expert Birmingham 23



**BALANCING FOR THE TRADE**

We can offer balancing capacity on Jackson-Bradwell Balancing equipment for weights from 5lb. to 400lb. and lengths up to 39". All work is carried out promptly by experts at reasonable prices. Send us your enquiries.

**BALANCING & TECHNICAL SERVICES**

GROVE HOUSE, SUTTON NEW ROAD, BIRMINGHAM, 23

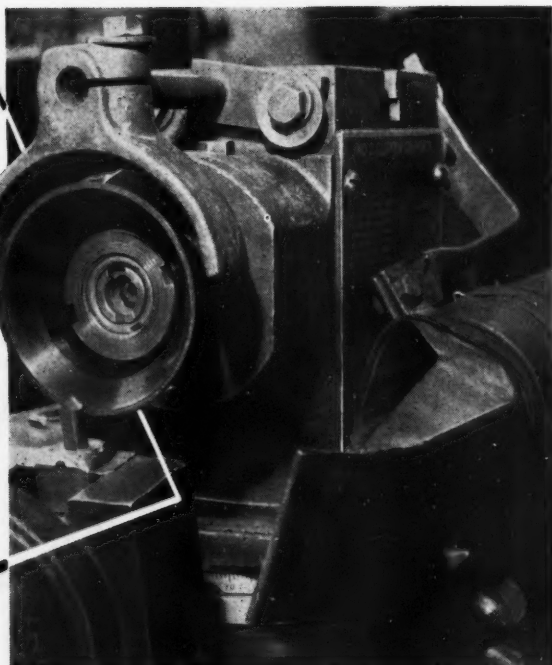
Telephone Numbers: ERDington 7411/2



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**Making the NEW**
**Automatic 35 TRANSMISSION**

*For  
Shaping  
and  
Finishing  
Carbide  
Tools  
BORG-WARNER LTD  
we*



# DIAGRIT *Resinoid Bonded* DIAMOND WHEELS

At BORG - WARNER Ltd., Letchworth, as in scores of other leading firms, DIAGRIT diamond wheels have proved their ability to combine rapid metal removal with the fine finish so necessary for maximum cutting efficiency. Diagrit Diamond Tools may well

be able to reduce your production costs. There is a large range from which to choose and we are always happy to advise you. Fill in the coupon below for details of full range of diamond tools and hones.

Fill in and post  
this coupon now  
for full details  
and our latest  
Catalogue  
& Price List to:



Name.....  
Address.....  
..... Ref. D/D8

DIAGRIT DIAMOND TOOLS LTD., Station Road, Staplehurst, Tonbridge, Kent.

Tel: Staplehurst 479.

Grams: Diagrit, Staplehurst

When answering advertisements kindly mention **MACHINERY**.

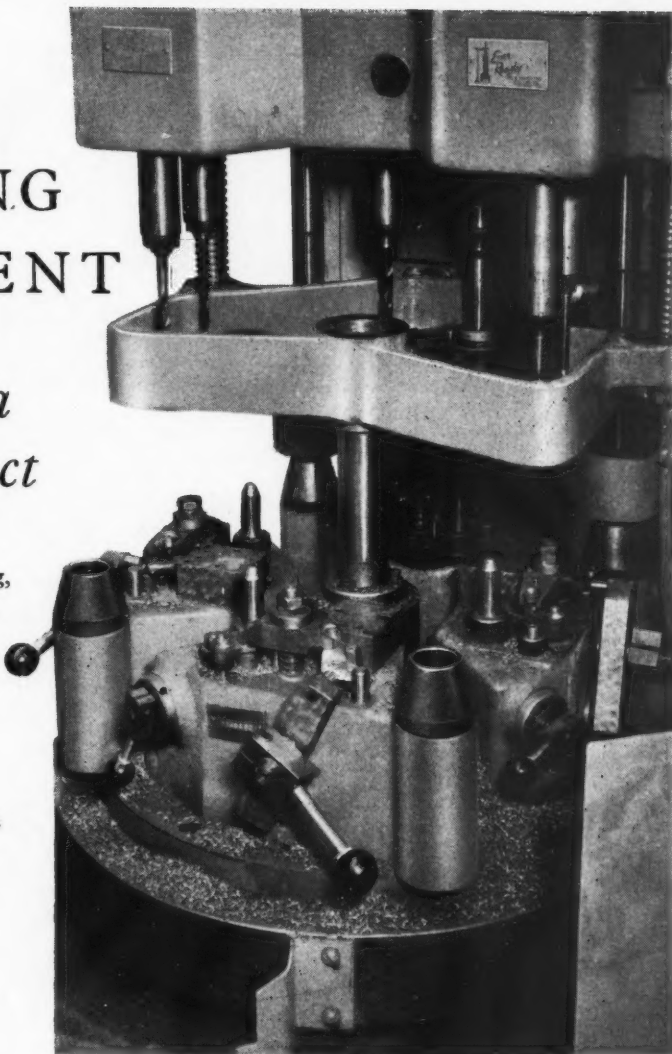
**Making the NEW****Automatic 35 TRANSMISSION****FINE  
TOOLING  
EQUIPMENT**

*... for a  
fine product*

We illustrate a fixture for drilling, reaming and spot facing parking brake toggle levers . . . . . one of many items of tooling equipment we have supplied for the production of the new BORG-WARNER automatic '35' Transmission.

We are specialists in jigs, fixtures and tooling equipment and welcome your enquiries.

Get in touch with us.



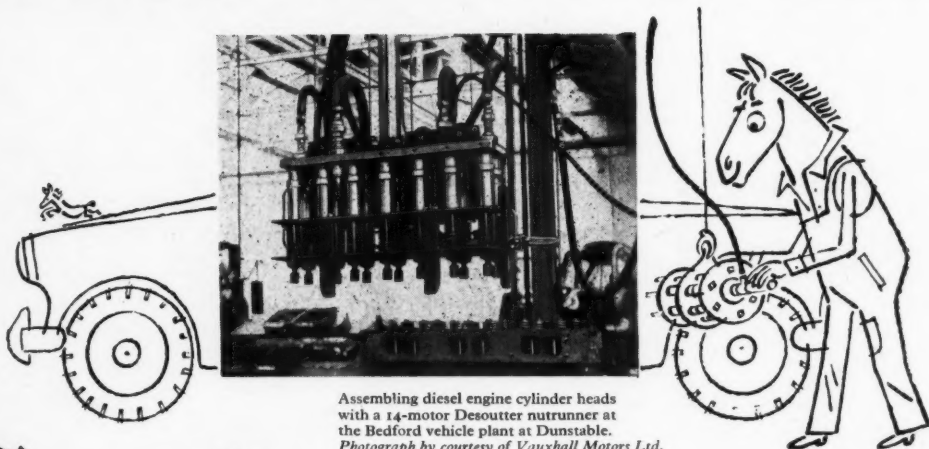
*Ever  
Ready*

**TOOL & ENGINEERING CO. LTD.**

97/99 HAINAULT ROAD • ROMFORD • ESSEX

Telephone: ROMFORD 62262/3

*When answering advertisements kindly mention MACHINERY.*

**Making the NEW****Automatic 35 TRANSMISSION**

Assembling diesel engine cylinder heads with a 14-motor Desoutter nutrunner at the Bedford vehicle plant at Dunstable.  
*Photograph by courtesy of Vauxhall Motors Ltd.*

**Desoutter** in the Motor Industry

Without Desoutter power tools there would be no mass production. You may disagree, but that's our story and we're sticking to it. Come to think of it, do you know anything as fast, as reliable, as non-stop as a Desoutter power tool? Neither do we.

Our range of pneumatic and electric tools is nothing if not wide. But should you find a gap, we'll do our best to fill it for you. In certain cases we're prepared to produce an entirely new tool for a specific job. Write today for further details of Desoutter tools for the motor industry.



A Desoutter pneumatic tool engaged on the countersinking of holes in lower valve bodies at the Borg-Warner factory at Letchworth.  
*Photograph by courtesy of Borg-Warner Ltd.*

**Desoutter** pneumatic and electric tools  
put power into your hands

Desoutter Bros. Limited, The Hyde, Hendon, London, N.W.9.  
Telephone: Colindale 6346 (5 lines). Grams: Despucco, London, N.W.9.

CRC/DT 352

**— Making the NEW —**



**Automatic 35 TRANSMISSION**



**BOMA**

**MULTI-DRILLING HEADS  
AND FIXTURES**

**... play their part in the production  
of this new transmission**

In the well-equipped factory of Borg-Warner Limited, Letchworth, BOMA multi-drill heads and fixtures are used for operations on a variety of components.

We specialise in the design and production of tooling equipment of every kind . . . from a single jig to tooling for a complete manufacturing scheme. Consult us on your own production problems.

**BOMA**

**ENGINEERING (BILSTON) LTD.  
DIXON STREET, WOLVERHAMPTON  
TELEPHONE: WOLVERHAMPTON 26941 2**



**WE ALSO MAKE**

**SPECIAL PURPOSE MACHINES.  
JIGS, FIXTURES, GAUGES.  
PRESS TOOLS & TOOLING EQUIPMENT  
OF EVERY KIND.**

*Your enquiries will be welcome*

**'BOMA KNOW-HOW' GETS YOUR PRODUCTION PROBLEMS IRONED OUT !**

A MEMBER OF THE LAYSTALL GROUP OF COMPANIES

*When answering advertisements kindly mention MACHINERY.*

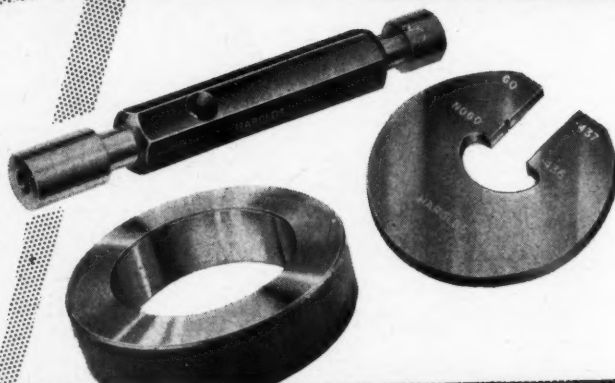


## Making the NEW



# Automatic 35 TRANSMISSION

**Suppliers of  
plug, gap,  
ring and  
profile  
gauges  
to Borg-Warner**

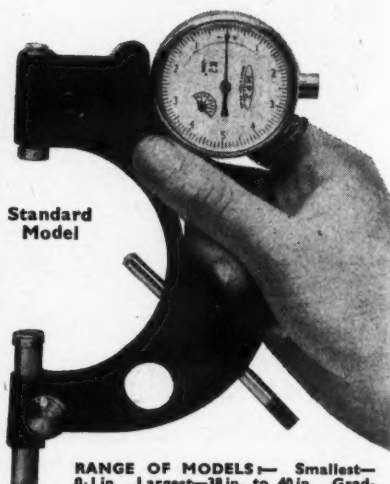
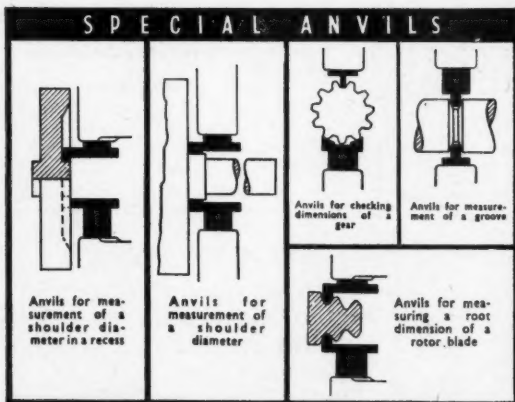


**HAROLDS GAUGES LTD. 56/57 FREDERICK ST., BIRMINGHAM, 1 (CENTRAL 5679) and 6732**



## DIAL SNAP GAUGES MODEL "D"

The illustration shows special anvils fitted by us to suit particular requirements



Standard Model

**RANGE OF MODELS**— Smallest—0.1 in. Largest—38 in. to 40 in. Graduations—0.005 in., 0.0001 in., 0.01 mm or 0.032 mm

**MPJ GAUGE AND TOOL CO. LTD.**  
**ERDINGTON · BIRMINGHAM · 24**  
 Member of the Gauge and Toolmakers' Association

used extensively in

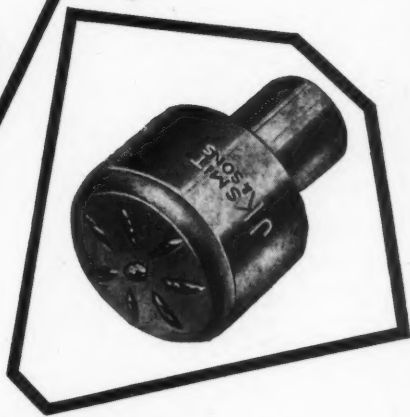
## Making the NEW



# Automatic 35 TRANSMISSION

**Making the NEW****Automatic 35 TRANSMISSION****with J.K.S Diamond products**

With over seventy successful years of experience behind us, we offer you a range of diamond tools equalled in their efficiency only by the skill of the craftsmen who use them.



Diamond tools for straight and centreless grinding, step and thread grinding, form and radius grinding, boring and turning.

Diamond wheels, Diamond hand hones, Diamond powder, Mirra-Lap diamond lapping compound, Diamond saw blades, Diamond thin wall core bits.

**J. K. SMIT & SONS DIAMOND TOOLS LTD.**  
22/24 Ely Place, Holborn Circus, London E.C.1. Tel. Holborn 6451

**JKS**

Manchester Office  
2 St. John Street,  
Deansgate  
Manchester 3  
Blackfriars 0443  
and 4866

**Sales and Service:**

Factory: Mochdre,  
Colwyn Bay,  
Denbighshire,  
North Wales,  
Colwyn Bay 44212/4

Midland Office  
14 Queens Road  
Coventry  
Coventry 25215



When answering advertisements kindly mention MACHINERY.

**Making the NEW****Automatic 35 TRANSMISSION****TAY  
GEAR SHAPER  
CUTTERS**

We are specialists in the design and manufacture of FELLOWS type gear shaper cutters and CORNELIS type thread generating cutters.

Our photograph shows a TAY cutter in use on a MAXICUT gear shaper at Borg-Warner Ltd., cutting splines in front drums for the new '35' automatic transmission.

Write today for complete catalogue No. 21 of standard cutters.

**TAY TOOL WORKS LTD****SPON LANE & BELL STREET • WEST BROMWICH • STAFFS**

Phone: WEST BROMWICH 2291/2 Grams: GEARSHAPER, WEST BROMWICH



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— **Making the NEW** —



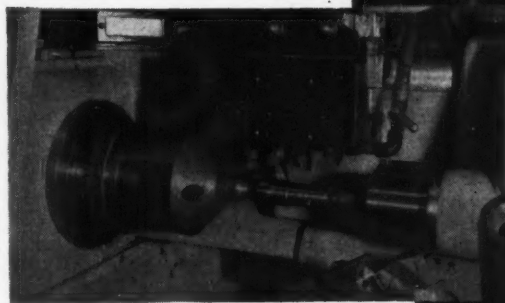
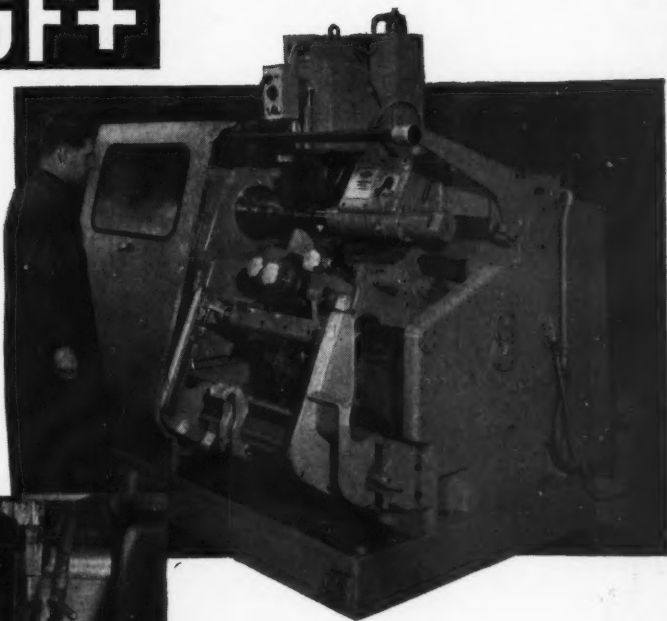
**Automatic 35 TRANSMISSION**

**For Productive Capacity . . . and All-Round Reliability**  
**BORG-WARNER select**

**+GF+**

## Copying Lathes

ensure greatly reduced production times by the use of multiple single tool copy turning. There are four new models with independent upper and lower slides giving internal and external copy turning in both directions. Complete details and times on your own work gladly given on request.



**LET US DEMONSTRATE TO YOU**



Our photographs show the machining of reverse sun gear blanks in the plant of Borg-Warner Ltd., Letchworth. The blanks are completely machined in a cycle time of 52 seconds. Material S.A.E. 4047.

**VAUGHAN**  
**ASSOCIATES LIMITED**

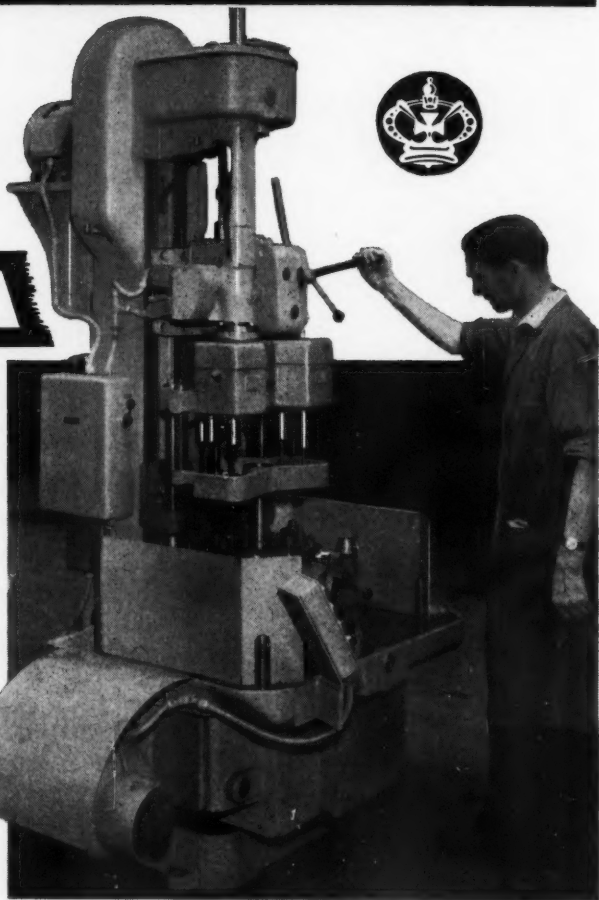
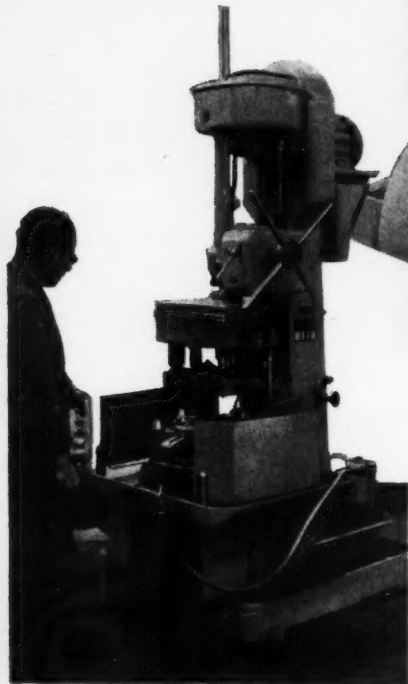
**4 QUEEN STREET, CURZON STREET, LONDON, W.1**  
 Tel: GRCsvenor 8362

Midland Office and Demonstration Room  
**WILFRED CRESCENT, NOTTINGHAM, Tel: NOTT. 88008**

*When answering advertisements kindly mention MACHINERY.*

**Making the NEW****Automatic 35 TRANSMISSION***For extra  
production***CORONA**

MODEL 21A

**MULTI-SPINDLE  
OPERATIONS**

The machines shown are typical of many CORONA drills selected by BORG-WARNER LTD., for the production of the new transmission.

These machines are available with from one to six columns, with single or multi-heads tooled ready for production. Manual or power indexing tables can be arranged with as many stations as required.

**FREDK POLLARD & CO LTD**

CORONA WORKS, LEICESTER, ENGLAND. Tel: LEICESTER 67534 (5 lines)

LONDON: COASTAL CHAMBERS, 15 ELIZABETH ST., BUCKINGHAM PALACE RD., S.W.1

TEL: SLOANE 8880

SCOTLAND: W. S. LANG & CO., 48 OSWALD STREET, GLASGOW, C.1. TEL: CENTRAL 2539

NORTH EAST ENGLAND: MESSRS. HODSON MACHINE TOOLS LTD., 150 NEW BRIDGE ST., NEWCASTLE. TEL: 27388

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**Making the NEW**



**Automatic 35 TRANSMISSION**



For precise control of heat treatment — treatment in respect of both uniformity of temperature and time, Borg-Warner specify Wild-Barfield Forced Air Circulation Furnaces.



**FOR ALL HEAT-TREATMENT EQUIPMENT**

**WILD-BARFIELD ELECTRIC FURNACES LTD · ELECFURN WORKS · OTTERSPOOL WAY · WATFORD BY-PASS · WATFORD · HERTS**

Telephone: WATFORD 26091 (8 lines) Grams: ELECFURN, WATFORD

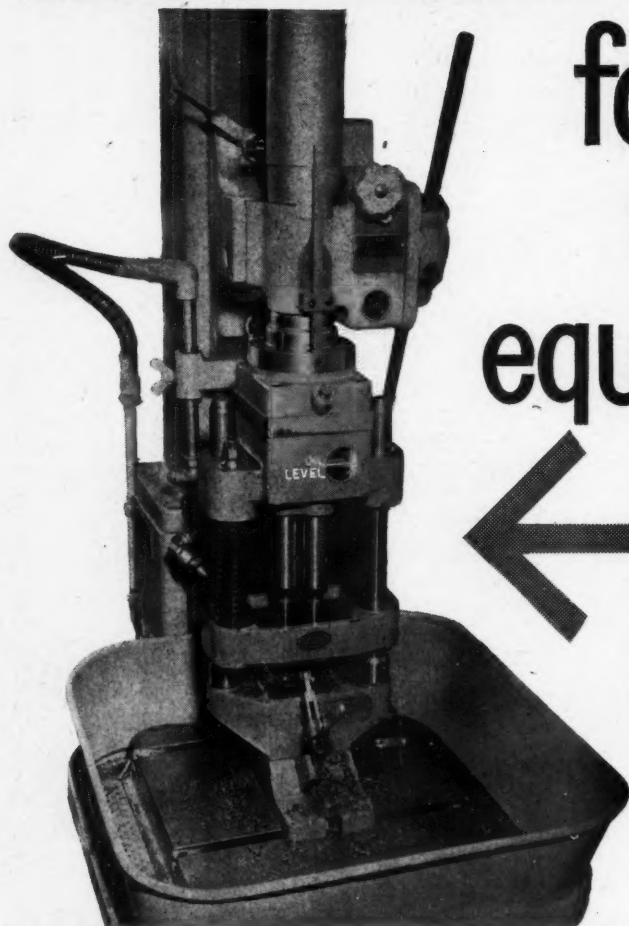
W312\*

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**Making the NEW**



**Automatic 35 TRANSMISSION**



**for fine tooling equipment**



**design and manufacture**

*Illustration shows drill head and fixture for the simultaneous drilling and countersinking of converter cover plates.*

**Consult**

**C. B. POWELL LIMITED**

1 ST. JOSEPH'S CLOSE, HOVE, SUSSEX

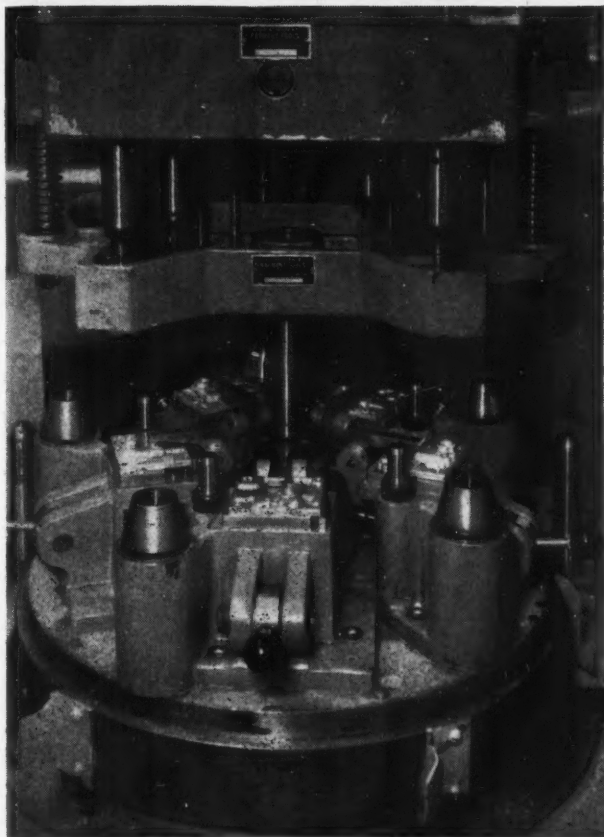
TELEPHONE : HOVE 71144

ESTABLISHED 1945

## Making the NEW



# Automatic 35 TRANSMISSION



## High Class

### MULTI-DRILLING HEADS & FIXTURES

We illustrate two typical drilling and reaming heads and indexing fixtures built by us for speedy and precise operation on components in the fine plant of Borg-Warner Ltd., Letchworth.

We are tooling specialists and we invite your enquiries.

Get in touch with us.



We also specialise in

**SPECIAL PURPOSE  
MACHINES,  
JIGS & FIXTURES, ETC.**

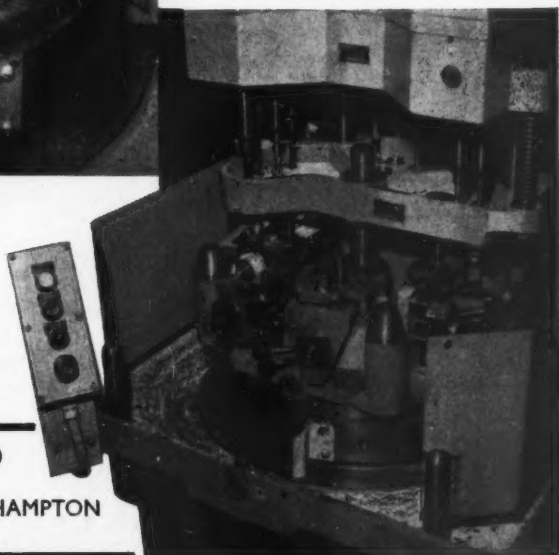
PROMPT ATTENTION TO ALL ENQUIRIES

**RAYMENT TOOLS LTD**

HAVANT BUILDINGS

MILLBROOK ROAD, MILLBROOK, SOUTHAMPTON

TELEPHONE: SOUTHAMPTON 74185



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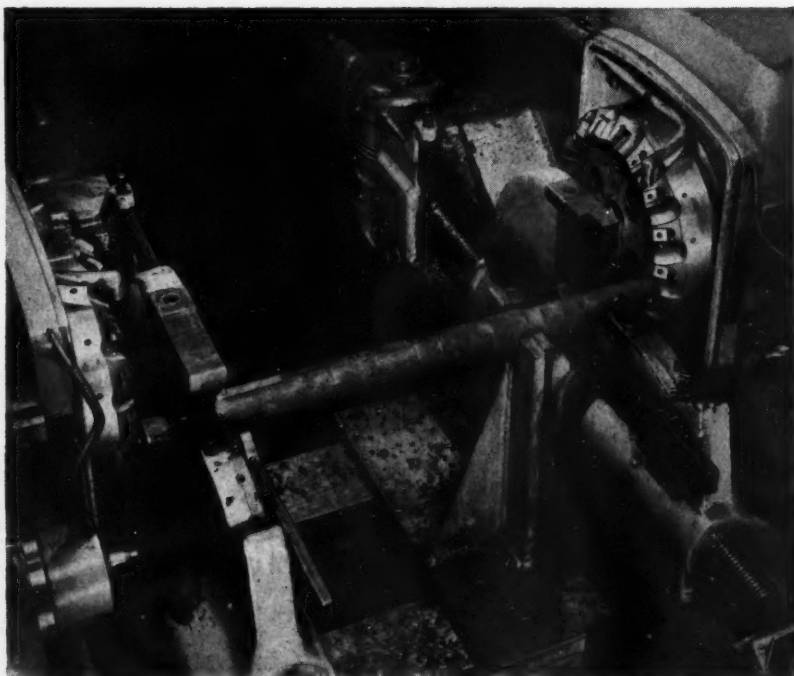
**Making the NEW**



**Automatic 35 TRANSMISSION**

# 2 **Prolite** FUTURMILLS.★

are used on a Fraser Endomatic machine for Facing Shafts in SAE 5140, heat-treated to 28-32 Rockwell C.



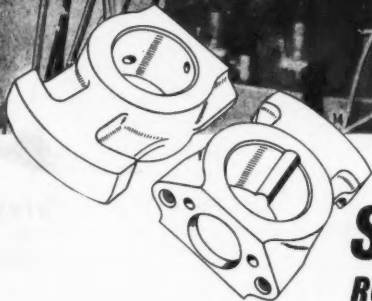
- ★  
Throwaway  
Tips
- ★  
No cutter  
grinding
- ★  
Long tool  
life
- ★  
Economic  
production

Other applications of 'Prolite' Cemented Tungsten Carbide at the Borg-Warner works include many standard and special form tools used for turning, boring and facing.

**Consult us on all your tooling problems.**

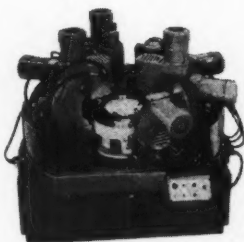
**Home Sales:** **PROTOLITE LIMITED** (a subsidiary company of Murex Ltd.) RAINHAM, ESSEX.  
 Telephone: Rainham, Essex 3322. Telex 28632. Telegrams: Protolite, Rainham-Dagenham Telex.  
 Southern Area Office: Central House, Upper Woburn Place, London, W.C.1.  
 Midland Area Office: Guildhall Buildings, Navigation Street, Birmingham, 2.  
 Northern Area Office: Norwich Union Buildings, City Square, Leeds, 1.  
**Export Sales:** **MUREX LIMITED** (Powder Metallurgy Division), RAINHAM, ESSEX, ENGLAND.  
 Telephone: Rainham, Essex 3322. Telex 28632. Telegrams: Murex Rainham-Dagenham Telex.

When answering advertisements kindly mention MACHINERY.

**Making the NEW****Automatic 35 TRANSMISSION**

## **SCHAUBLIN 20**

### **ROTARY TRANSFER MACHINE**



Small components requiring a variety of machining operations at mass production rates are most economically produced on the Schaublin 20.

Comprising up to eight individual working stations and as many as eleven motor-driven machining heads, this Swiss-built precision automatic handles turning, milling, drilling, screwing and tapping operations of the most complex character with consummate ease.

Its unit-built design and range of hydraulically operated universal and interchangeable work heads enable it to be quickly set up for a particular component, and equally quickly changed over to another. It therefore offers all the advantages of automatic transfer machining with, in addition, the flexibility of application required for medium and small batch production.

Cycle times are infinitely variable between two and forty seconds, the maximum machining area being 4" x 4" in any plane, and turning capacity 4" diameter.

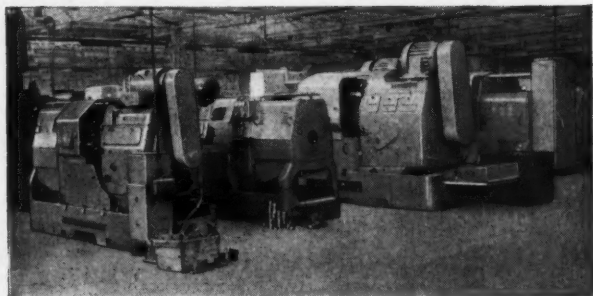
**WICKMAN****LIMITED**

FACTORED MACHINE TOOL DIVISION BANNER LANE, COVENTRY

Telephone: Tile Hill 65231

*When answering advertisements kindly mention MACHINERY.*



**Making the NEW****Automatic 35 TRANSMISSION**

Batteries of B.S.A. ACME-GRIDLEY 5½ in., 6 in., & 7½ in. multi-spindle chucking automatics at BORG-WARNER.  
(Photos by courtesy)

Machines supplied to Borg-Warner by B.S.A. TOOLS LIMITED (and associates) include B.S.A. Acme-Gridley chucking automatics (*above*), Churchill HBA automatic grinder (*right*), and B.S.A. tapping and Maag gear testing machines.

We are proud that plant furnished by the B.S.A. Tools Group is engaged in this great Borg-Warner project.

**B.S.A. TOOLS LIMITED**

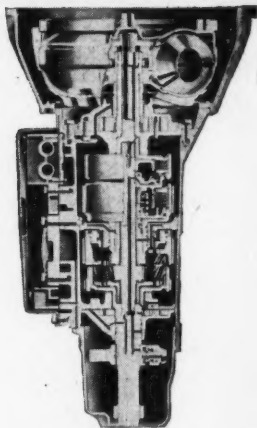
*High Production Machine Tools*

**BURTON GRIFFITHS & CO LTD**

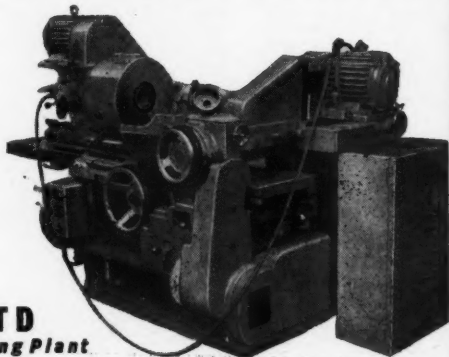
*British, American and Continental Metal working Plant*

(B.S.A. TOOLS GROUP)

Mackadown Lane · Kites Green · Birmingham. 33.  
Telephone STECHFORD 4071.



**B.S.A. machines are employed extensively in the production of components for the BORG-WARNER '35' Automatic Transmission**



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controlled  
variable  
speed

**Kopp** VARIATORS

- Range  $\frac{1}{33}$  h.p. to 15 h.p.
- 9 to 1 stepless speed variation.
- Flange mounted motors (when required).
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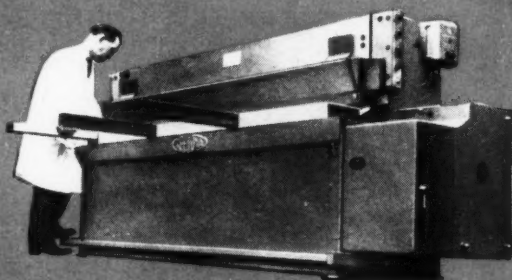
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 Royal Works · Clayton-le-Moors, P.O. Box 43, Accrington, Lancashire · Telephone Accrington 35441 (6 lines)  
 Technical Representatives in LONDON · BIRMINGHAM · MANCHESTER · LEEDS · BRISTOL · GLASGOW

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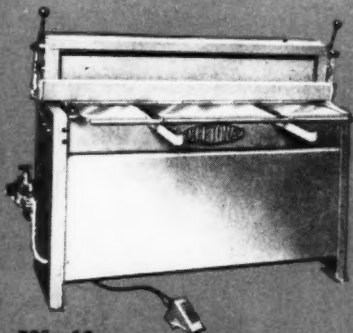


## Shears and Bending Rolls

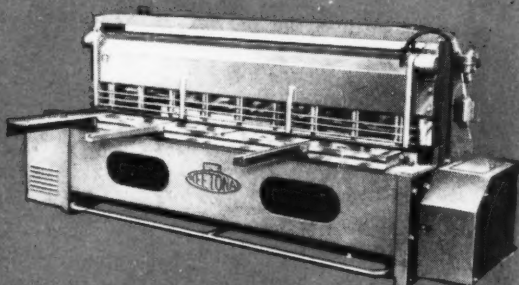
Streamlined design and fabricated steel construction are two of the outstanding features of Keetona Sheet Metal Working Machines. The examples shown here give some idea of the wide range we make—please write for full information. Hire purchase terms available.



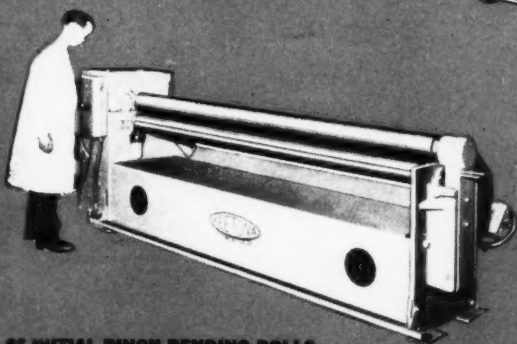
78" x 10 ga. SHEAR



50" x 16 ga.  
AIR OPERATED SHEAR



96" x  $\frac{1}{4}$ " SHEAR  
There is a full range of  
Keetona Shears in capacities  
from 40" x 16 ga. to 120" x  $\frac{1}{4}$ "



6" INITIAL PINCH BENDING ROLLS  
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ALSO PYRAMID BENDING ROLLS  
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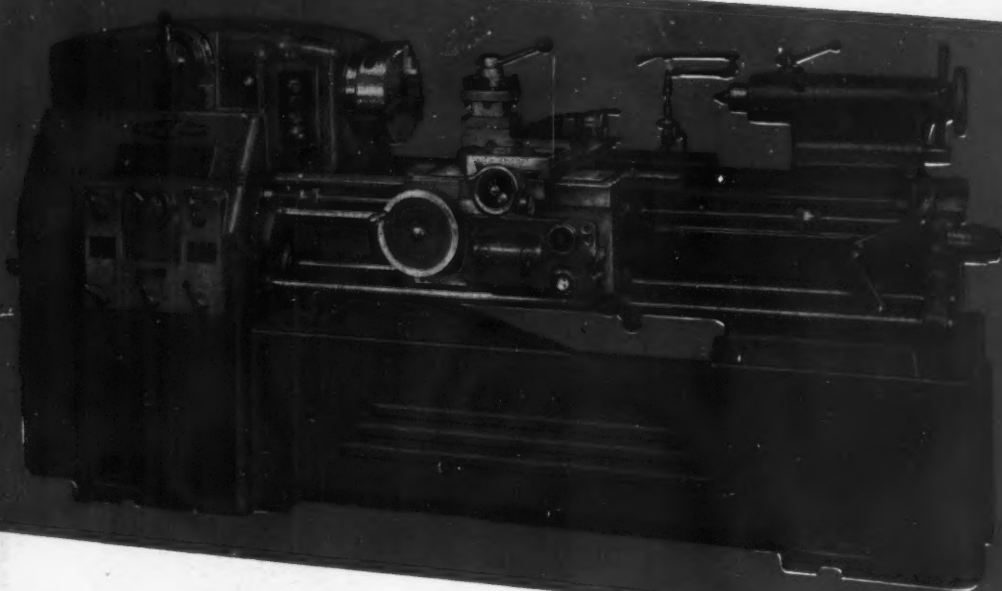
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# ***Introducing the NEW*** **MODEL 'H' No. 17** **PRECISION LATHE**



**INCORPORATING THE FOLLOWING FEATURES—**

16 SPINDLE SPEEDS (FORWARD AND REVERSE) WITH SINGLE LEVER CONTROL.

CAM-LOCK SPINDLE NOSE, 2 $\frac{1}{8}$ " DIA. HOLE  
SINGLE HELICAL GROUND GEAR, FINAL DRIVE.  
TOTALLY ENCLOSED GEARBOX AND APRON.  
60 DIRECT CHANGES OF THREADS AND FEEDS.  
PRECISION LEADSCREW AND COMPENSATED THRUST.

**ALSO AVAILABLE—**

ALTERNATIVE SPEED RANGE, BED LENGTH, RAPID POWER TRAVERSE, TWO-SPEED TAILSTOCK.

**STANDARD MODEL**  
**20" SWING OVER BED**  
**42" BETWEEN CENTRES**  
**SPINDLE SPEEDS 15-1000 R.P.M.**

HYDRAULIC PROFILING EQUIPMENT  
TAPERING EQUIPMENT ETC.

**HOLBROOK**  
**MACHINE TOOL CO. LTD.**

**CAMBRIDGE ROAD, HARLOW, ESSEX**

Telephone :  
**HARLOW 2351**

**GOOD TEETH...***Assurance, skill,  
accuracy***WORM GEARS**

From  $\frac{1}{4}$  in. to 15 in. diameter  
Maximum DP 6

**WEEKS AND WILSON LTD.***GEARS AND GEAR CUTTING*

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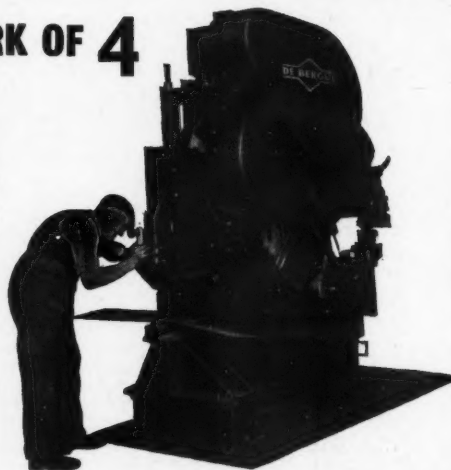
**THIS MACHINE DOES THE WORK OF 4****TAKES UP THE SPACE OF 1**

- PUNCHING
- SECTION CROPPING
- PLATE SLITTING
- NOTCHING

**BERGUE 4 IN 1**  
MULTI-PURPOSE MACHINE

SEND FOR BROCHURE (M)

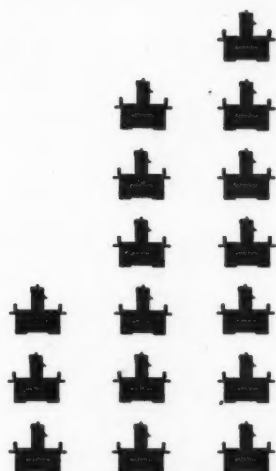
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A new range of Guillotines of modern design will shortly be available. Full particulars on request.

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*From a  
range of  
**51**  
basic models  
there  
must be*



**one**

## **ELB Surface Grinder**

*to meet  
your  
particular  
requirements*

A MACHINE  
WITH  
24in. by 20in.  
GRINDING  
CAPACITY  
AVAILABLE  
NOW



Ask now for a copy of the new 90-page  
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**SOAG MACHINE TOOLS LTD**

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# 40% INCREASE IN PRODUCTION



for only **10%**  
**EXTRA EXPENDITURE**



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## USING **KE** 40A

High-speed automatic lathes producing piece parts have been able to increase production by as much as 40% — merely by using **KE 40 A FREE-CUTTING STAINLESS IRON** in place of the EN 56A type of stainless iron.

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REBUILDING

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OVER A  
QUARTER OF  
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EXPERIENCE

NEWMAN INDUSTRIES LIMITED

YATE · BRISTOL · ENGLAND

Telephone: Chipping Sodbury 3311



The Kingfisher (*Alcedo ispida*) nests at the end of a narrow tunnel which it burrows into the bank of a stream, river, pond or lake. The burrow slopes gently upwards for many feet and once constructed is used for many years. In strange contrast to the brilliant plumage of the bird, its burrow is usually in a foul condition being littered with fish-bones and other refuse.

*The  
Alcedo Ispida  
is  
Efficient  
But hardly a*




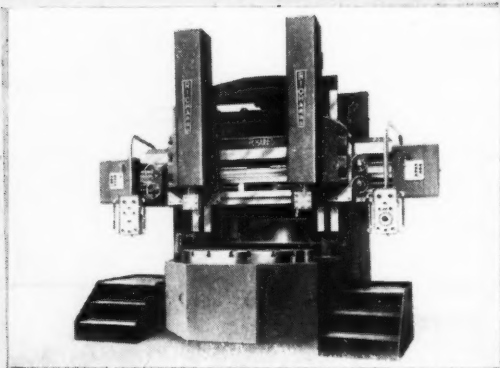
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HORIZONTAL and VERTICAL BORERS produced by GEORGE RICHARDS & CO. LTD., however are unsurpassed for precision speed and adaptability. Continuous research and development keep RICHARDS borers way ahead of all others.

Illustrated right is a RICHARDS VERTICAL BORING MILL, supplied in a range with table capacities from 5ft. to 10ft., with or without side-head. The complete range of machines includes table capacities up to 50ft.

# **RICHARDS**

SHAFLEY  GRADY



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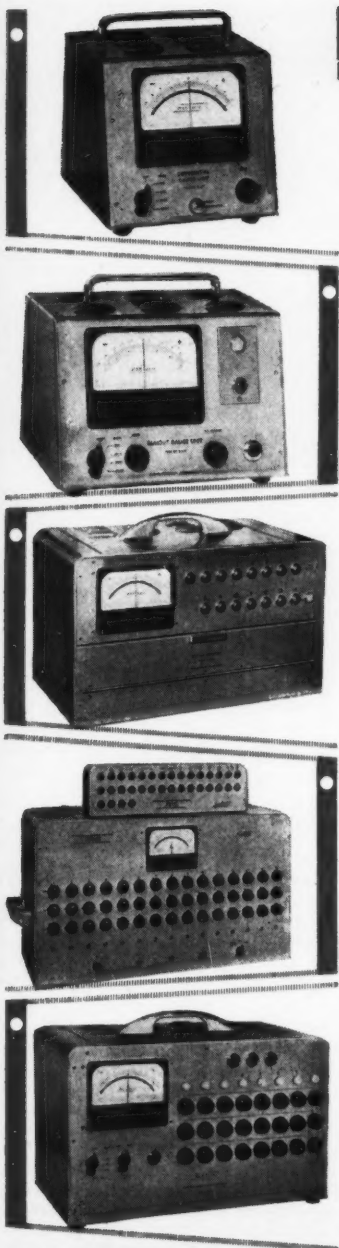
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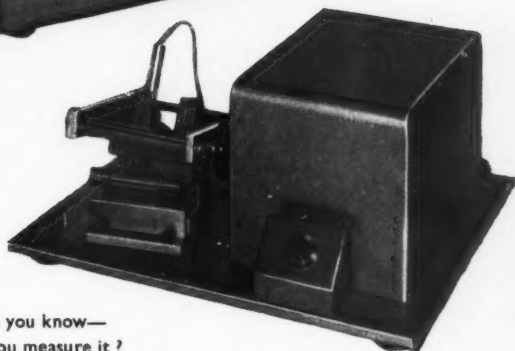








Yes—but HOW  
concentric?



And when you know—  
how do you measure it?

PARNUM automatic runout equipment does it all for you.  
Press the button—the piece revolves—the light signal shows  
the answer.

- FAST
- ACCURATE
- MISTAKES IMPOSSIBLE
- NO SKILL REQUIRED

RUNOUT GAUGE COMPLETE WITH PROBE.....£140

Please send for further information to

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ACCURATELY YOURS—



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Warner Electro Cam Oil Immersed Clutch

## AUTOMATIC SPEED CHANGE CONTROL

This is a job for Warner electric brakes and clutches. They can start and stop in milli-seconds. Power is disengaged and braking force applied—almost simultaneously! Moreover, each operation, be it starting or stopping, rapid cycling or accurate positioning, coupling or indexing, is carried out evenly and smoothly.

And Warner units are extremely compact. For example, a 3in. diameter clutch can exert 54 lb./ft. Standard units for ordinary braking, clutching or clutch-brake circuits can be integrated into all types of industrial machines. Torque measurements range from 2 lb./in. to 1350 lb./ft. Modifications of standard units, or special designs, can be undertaken to meet your particular needs.

Full details of the Warner standard range on request.



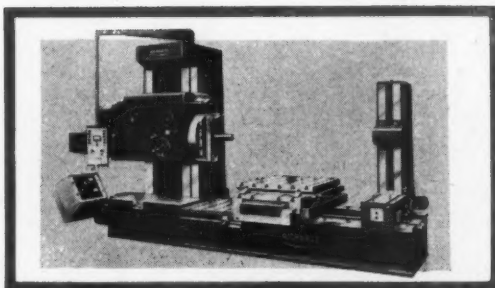


#### SOLVING A PROBLEM FOR THE GEORGE RICHARDS CO.

*The problem:* to ensure that the main spindle and facing head of this George Richards boring, facing and milling machine can be speed changed, automatically, over a wide range from push button pendant controls. *The solution:* Warner Electro-Magnetic oil-immersed Clutches. Their compact design enabled at least five clutches to be incorporated. By selecting the appropriate combination of clutches any desired speed is obtained. More Warner Clutches were used for the feed control of the spindle.

This is a typical example of how Warner electric brakes and clutches are helping industry to improve its machine tool capacity.

*Photo by courtesy of the George Richards & Co. Ltd., Broadheath, Altrincham*



# WARNER

## Electric Brakes and Clutches



**St. HELEN'S AUCKLAND · CO. DURHAM**

Phone: West Auckland 551 (6 lines)

Grams: Solenoid, West Auckland

London Office: 2 Ashley Place, Carlisle Place, London, S.W.1. Phone: VICTORIA 7301/2

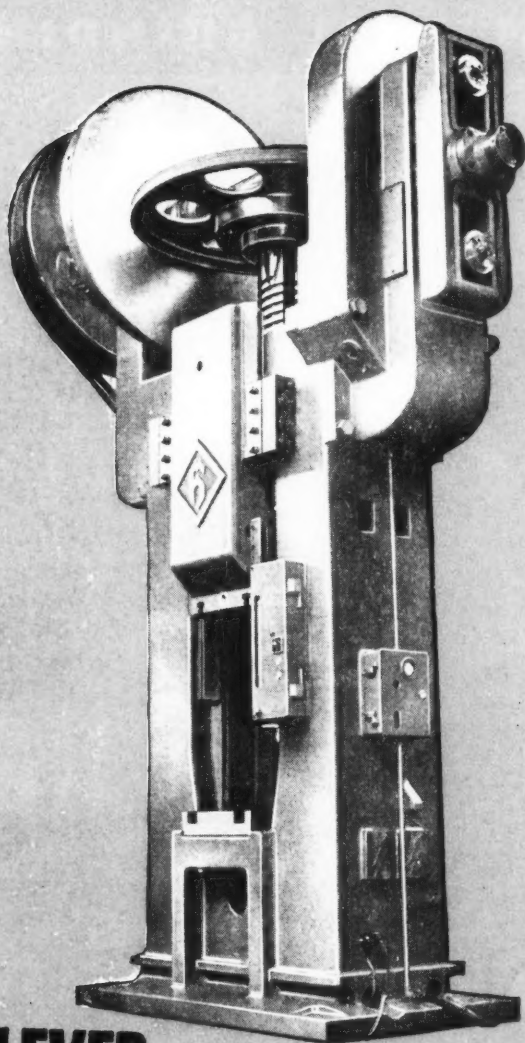
Birmingham Office: Silhill House, 2241 Coventry Road, Sheldon, Birmingham, 26. Phone: SHELDON 5121/2



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**IT'S PAUL GRANBY**

**FOR—**



# **HASENCLEVER**

## **Friction Screw Presses**

*with electronic variable blow selector*



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# PRECISION ROLL GRINDING...

rigidity

accuracy

DRONSFIELD'S

## ROLL GRINDING MACHINE

Specially suitable for all types of rubber rollers. Complete with Automatic Cambering Mechanism, Hydraulic Traverse, Water Coolage and Super Finishing Attachment.

AUTOMATIC CAMBERING MECHANISM



finish

HYDRAULIC TRAVERSE

### DRONSFIELD BROTHERS LTD

ATLAS WORKS • OLDHAM • ENGLAND

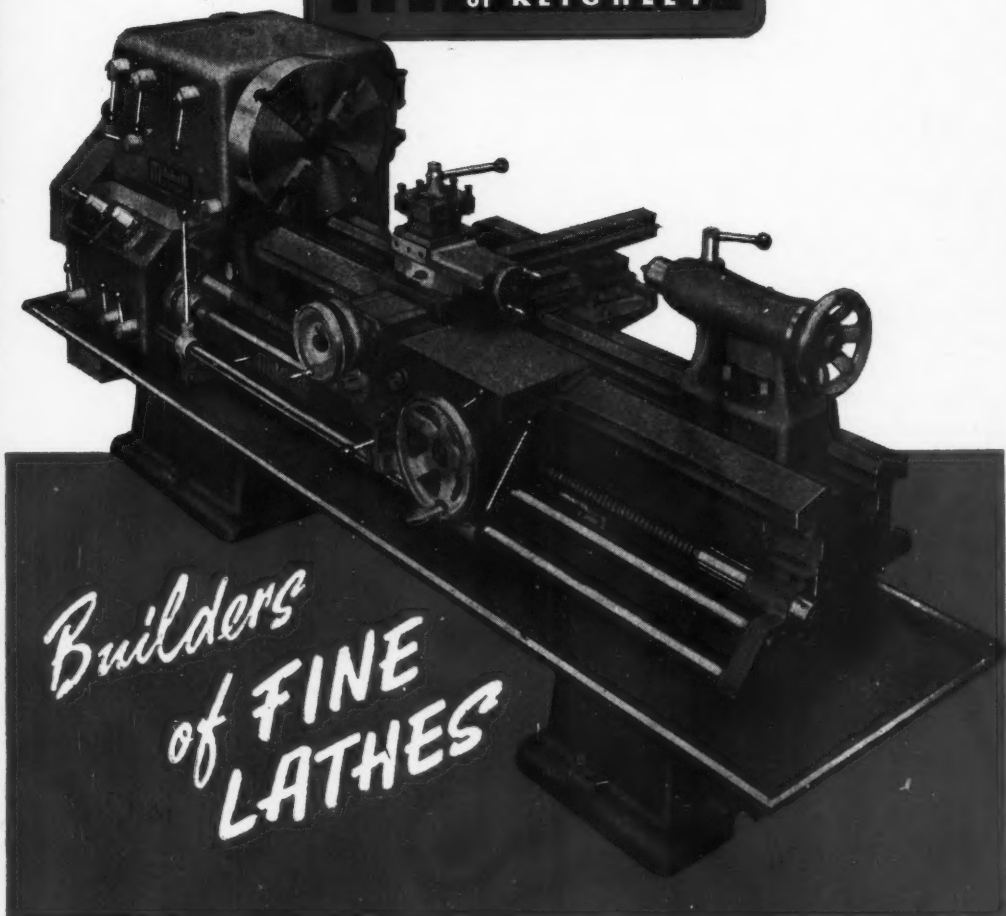
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## FROM 6½" TO 16½" HEIGHT OF CENTRES

These machines are built out of a long tradition of craftsmanship to the highest modern standard of design, productive capacity and precision. There are sizes and types to meet your own needs. Ask us to send you details.

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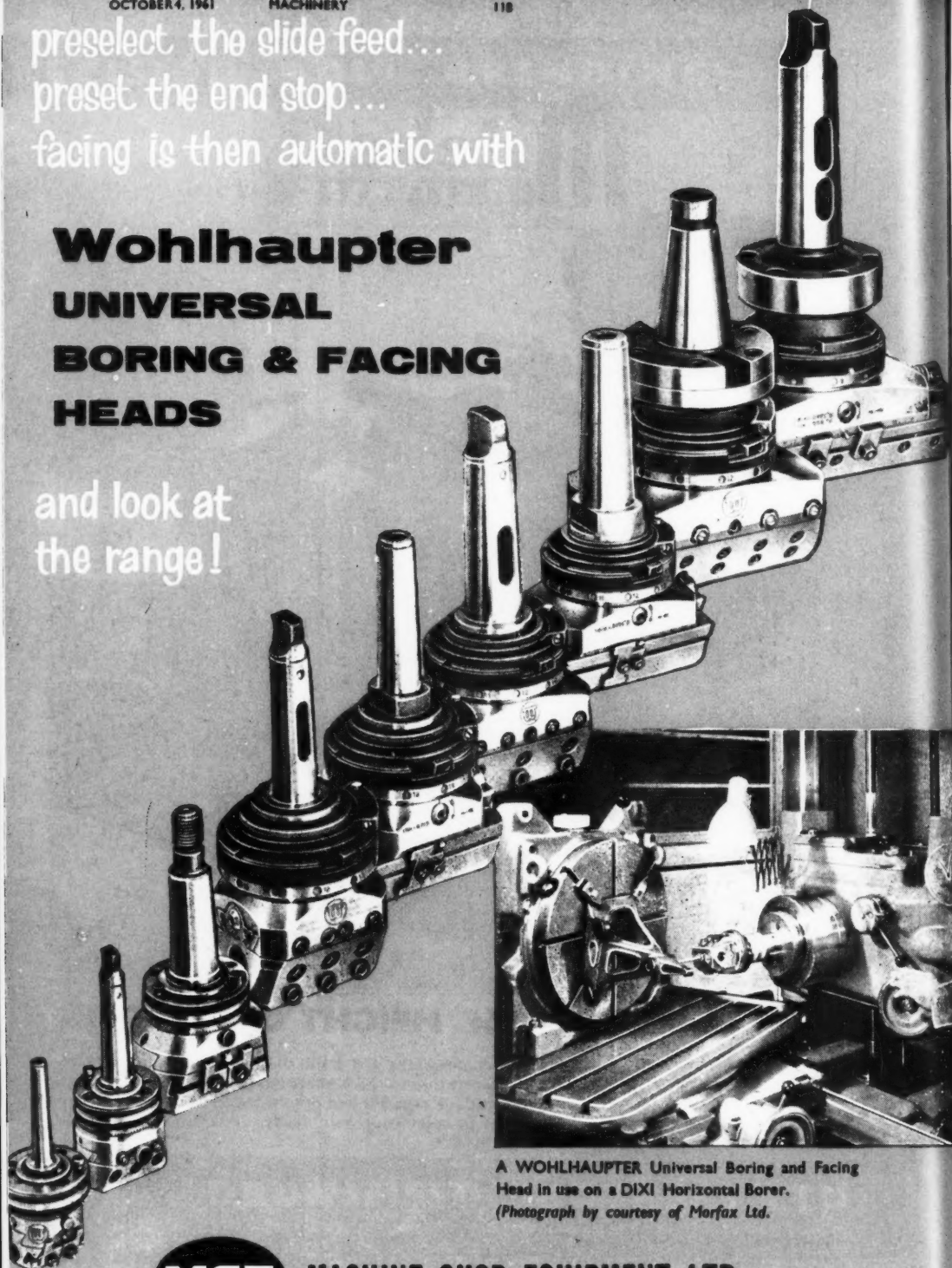
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Tel: Royal 1461 Cables: Morimil, London Grams: Morimil, Fan London

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preselect the slide feed...  
preset the end stop...  
facing is then automatic with

## **Wohlhaupter UNIVERSAL BORING & FACING HEADS**

and look at  
the range!



A WOHLHAUPTER Universal Boring and Facing Head in use on a DIXI Horizontal Borer.  
(Photograph by courtesy of Morfax Ltd.)

**MSE****MACHINE SHOP EQUIPMENT LTD.**

Spenser Street, London S.W.1 Telephone: VIctoria 6086





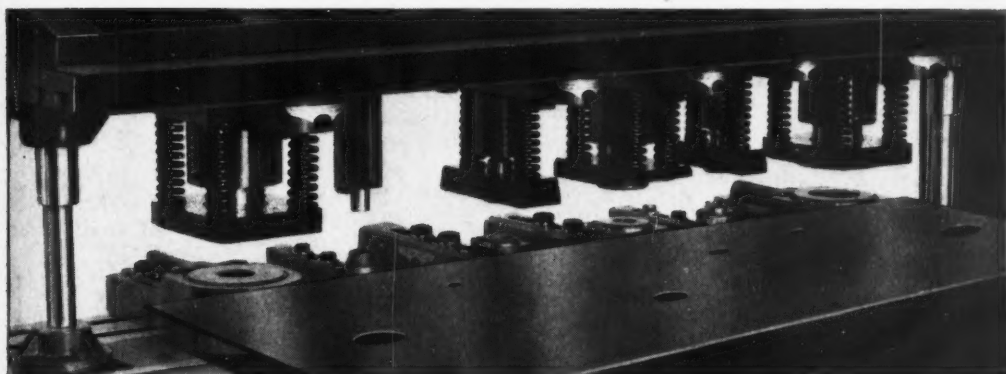
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## REDMAN UNIVERSAL TOOLING

### A NEW DEVELOPMENT IN THROUGH PIERCING

Incorporating the **HIGH STRIPPING** qualities and comparable capacities of Unipierce Tooling, and capable of being used alone or in conjunction with Standard Units. It also lends itself to automatic feed.

Component Setting is by Standard Redman Template in bottom bolster, by Master Template, or by linear measurement. While Punch and Die Setting is by positive Punch to Die, or by size plug to die, obviating the nipping of punches.



## THE NEW UNIVERSAL

We are Exhibiting  
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**INDUSTRIAL  
EQUIPMENT  
EXHIBITION**  
[ FREE ENTRY  
FOR ALL VISITORS ]  
**OCT. 17 to 26**  
1961  
**CITY HALL  
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MANCHESTER**  
ORGANISED BY  
PROBUCIAL EXHIBITIONS LTD

The life and accuracy of Punches, Dies and Strippers are known to users throughout the country.

Despite the obvious advantages of Unipierce Tooling, throat dimensions sometimes limits capacity.

**Universal tooling is then the answer.**

Castings are sturdy and streamlined and the Units themselves are backed by a Design Team having the greatest experience in **UNIT TOOLING** available in Great Britain today, while ancillary parts are up to the high standard already in use.

*Our representative will call and show you a sample set-up and demonstrate the setting on request.*

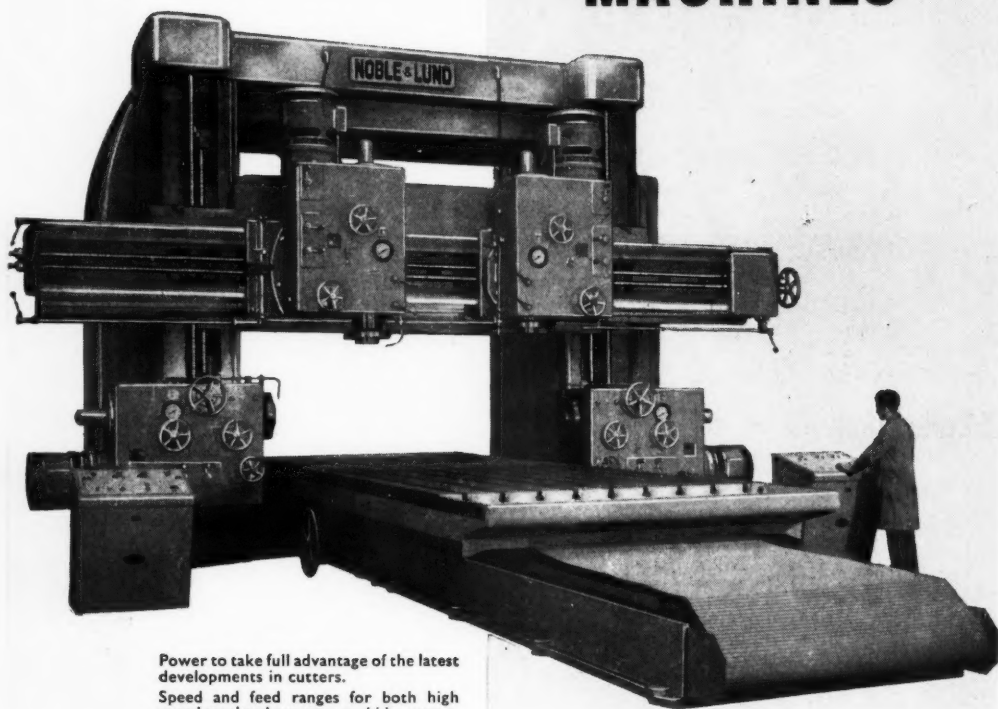
**REDMAN TOOLS & PRODUCTS LIMITED**  
**BOX No. M5, GREGORY'S BANK, WORCESTER**

Tel: Worcester 26933 (4 lines) Grams: Redtools, Worcester. Northern Agents: Dunmac Ltd., 123 Hope Street, Glasgow C2. Tel: Central 0421/2

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# *The Latest in* **PLANO-MILLING MACHINES**



Power to take full advantage of the latest developments in cutters.

Speed and feed ranges for both high speed steel and tungsten carbide cutters.

Power lock to cross slide.

Patented "FLUILINK" lubrication to bedways.

Jump feed incorporated as standard.

Extremely robust construction.

Control from dual desks or pendant as desired.

Sizes from 4ft. 0in. to 15ft. 0in. wide by any length.

**NOBLE & LUND LTD.  
NORTHERN MACHINE TOOL WORKS  
GATESHEAD 10**

TELEPHONE: FELLING 69-2272, 69-2677

TELEGRAMS: LATHES GATESHEAD

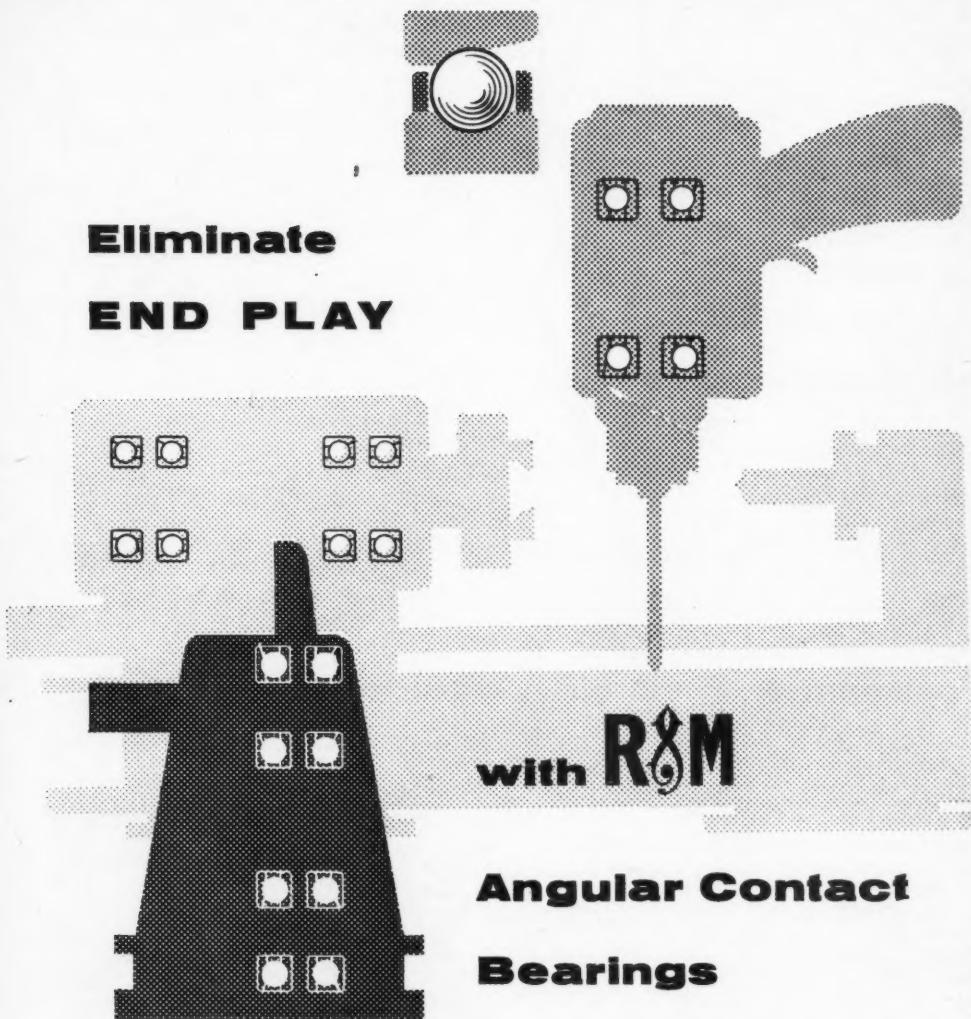
# **NOBLE & LUND**

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## Eliminate END PLAY



## Angular Contact Bearings

They meet the continuous high speed operation of a pump, maintain the precise setting of a lathe headstock, withstand the stop/start punishment of an electric drill —angular contact bearings are designed for every requirement of continuous thrust loading.

Ransome and Marles produce these bearings in a comprehensive range of sizes and tolerances. The designs can include built-in preload which eliminates shims or adjustments on assembly. The bearing specification can

be arranged to suit the precise requirements of any particular application.

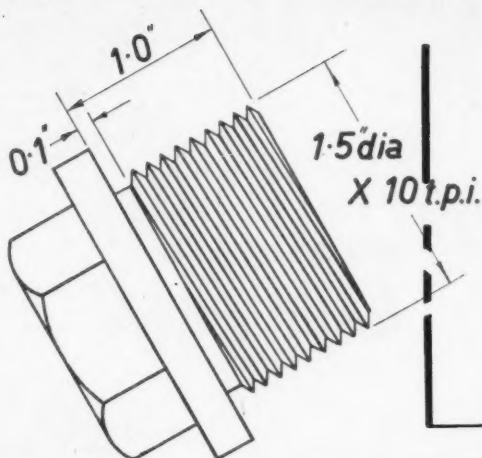
Ransome and Marles will be pleased to advise you on the application of angular contact bearings. Call them in when designing, developing or modifying machines of any type or size; their guidance is expert, impartial and confidential. Publication 37 is a comprehensive introduction to Ransome and Marles bearings.



**RANSOME & MARLES BEARING COMPANY LIMITED**  
NEWARK · ON-TRENT · NOTTS · TELEPHONE 456 · TELEX 37-626

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Could you screwcut  
this 'Nimonic 80'  
component in 25 secs.  
on a centre lathe?



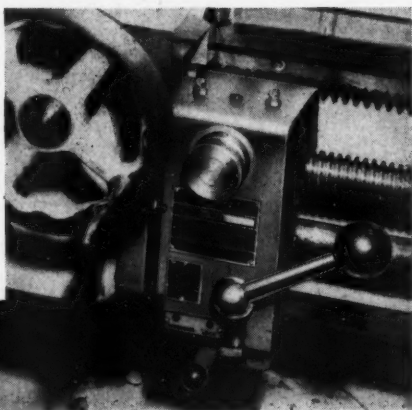
The answer is 'yes' if you fit an 'AINJEST'  
high speed screwcutting attachment!

For 1 off and upwards

Toolroom or Production — setting time is negligible.

In the same way that the chasing dial has superseded the old method of marking chuck, headstock, leadscrew collar and bracket; the AINJEST HIGH SPEED SCREWCUTTING ATTACHMENT has established a further major advance in screwcutting techniques. Its use on standard centre lathes allows the automatic engagement and disengagement of the leadscrew at the highest spindle speeds of which the machine is capable.

- ★ The cut cannot be started at the wrong point.
- ★ The cut is stopped accurately so that the external or internal threads can be cut tight to a shoulder at high speeds.
- ★ Tungsten carbide tools can be used with great advantage.
- ★ Chasing dial is eliminated.
- ★ The attachment remains in position, ready for use without restricting the versatility of the lathe.



High speed SCREWCUTTING ATTACHMENT

● stockists of "KENNET" carbide threading and turning tools

Write for details and prices to Dept. A.S.C.

SAUNDERSON & COSTIN LTD. • HIGHCLERE • NEWBURY • BERKS • ENGLAND • Tel: HIGHCLERE 448

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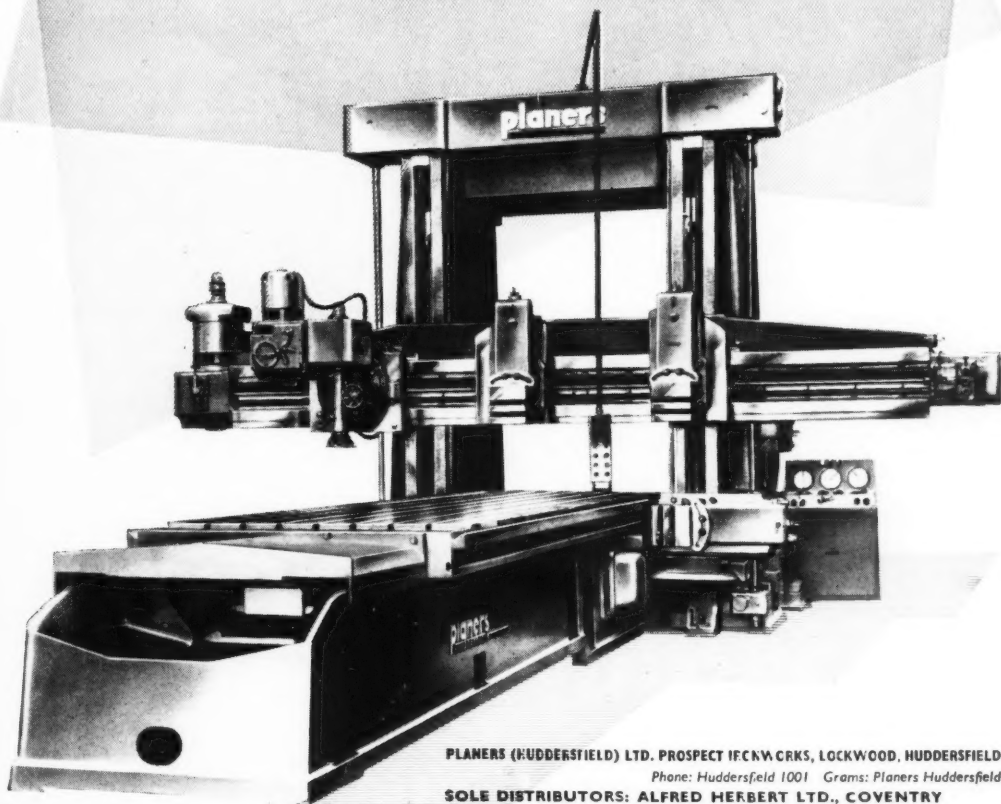
# *The Latest powerful*

**planers**  
HUDDERSFIELD • LIMITED

**HEAVY DUTY SPIRAL DRIVE PLANER  
WITH 10 H.P. MILLING HEAD**

UNSURPASSED FOR SPEED AND RIGIDITY ..

CAPACITY: 16FT. BY 6FT. BY 6FT.



PLANERS (HUDDERSFIELD) LTD. PROSPECT IF CNV CRKS, LOCKWOOD, HUDDERSFIELD

Phone: Huddersfield 1001 Grams: Planers Huddersfield

SOLE DISTRIBUTORS: ALFRED HERBERT LTD., COVENTRY

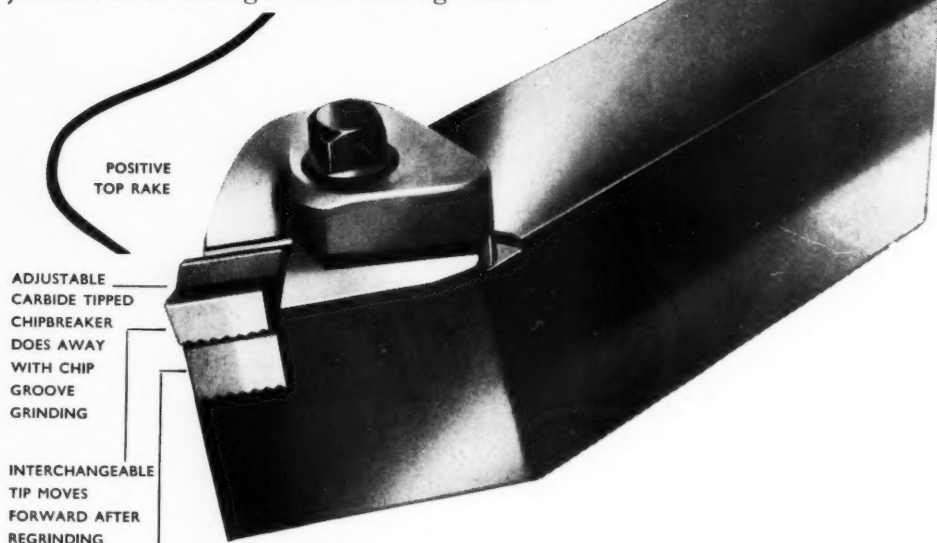
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## *It's New and Different!*

DO NOT CONFUSE WITH WHAT YOU MAY HAVE SEEN BEFORE

# **VERALOY CLAMP TOOL** *for use on* **FISCHER COPY LATHE**

*for which we are making the most extravagant claims*



*Constructed on the VERALOY PRINCIPLE OF MECHANICAL CLAMPING, this positive top rake tool will:*

- 1 Do all that a brazed tool does;
- 2 Do away with chip groove grinding;
- 3 Save you no end of money in purchase and regrinding cost;
- 4 Save space in the Stores and the Workshop;
- 5 Double the life of your machines by reducing the load on it as compared with negative rake clamp or throw-away tools.

*Standard Turning Tools  
on the same principle  
available.*

*Also tools for Copy  
Lathes of other makes*

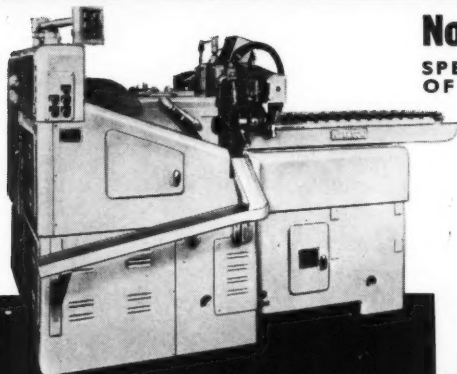
**VERALOY PRODUCTS LTD**



BEECH ROAD · THE MARSH · HIGH WYCOMBE · BUCKINGHAMSHIRE  
Telephone: High Wycombe 2795-8.      Telegrams: Veraloy High Wycombe

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# CO-ORDINATION . . . . .



## No 109 REVACYCLE MACHINE

**SPECIALLY ARRANGED FOR THE CUTTING OF AUTOMOTIVE STEERING SEGMENTS**

This machine presents the fastest method available for cutting teeth on automotive steering segments, such as those requiring a centre tooth size variation.

When equipped with the automatic loader, no operator is needed. The operator on the preceding machine merely places the blanks on the loading conveyor.

The automatic loader moves the blank to the work spindle by means of a conveyor; as a finished piece is ejected, a new blank is stock-divided and chucked in only 1.2 seconds. As this step takes place, the surplus oil drains from the segment just cut. The finished cut blank slides down the unloader chute.

# GLEASON

**EACH  
MACHINE  
PRODUCES**

**AUTOMATICALLY  
SOMETHING LIKE  
200 PIECES  
AN HOUR AT  
100%  
EFFICIENCY**

Highest productivity combining maximum economy is assured by working these machines—one with the other—the "Mult-au-Matic" for the production of the blank and the "Revacycle" for the cutting of the segments.

## CENTRE TURNING "MULT-AU-MATIC"

**TYPE 'L' 10 INCH 6-SPINDLE**

To ensure maximum productivity of this machine, you have individually selected spindle speeds and tool feeds rates at each station. Furthermore, it permits the use of modern cutting tools, methods and materials which also contribute to the reduction of your machining costs.

The "Mult-au-Matic" is available with 6 or 8 spindles with either 10in. or 14in. diameter chucks.

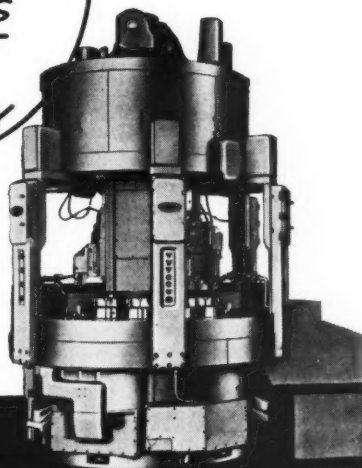
FULL DETAILS FROM SOLE AGENTS IN UNITED KINGDOM

# BUCK & HICKMAN LTD

Machine Tool Division—Otterspool Way, Watford By-pass, Watford, Herts.

Head Office—P.O. Box No. 74, Whitechapel Road, London, E.1.

Branches—Alperton, Birmingham, Bristol, Glasgow, Leeds, Manchester.



# BULLARD

**. . . for HIGHER PRODUCTIVITY**

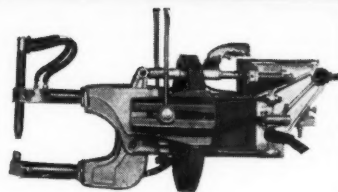


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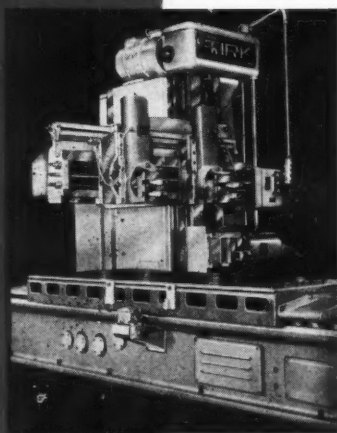
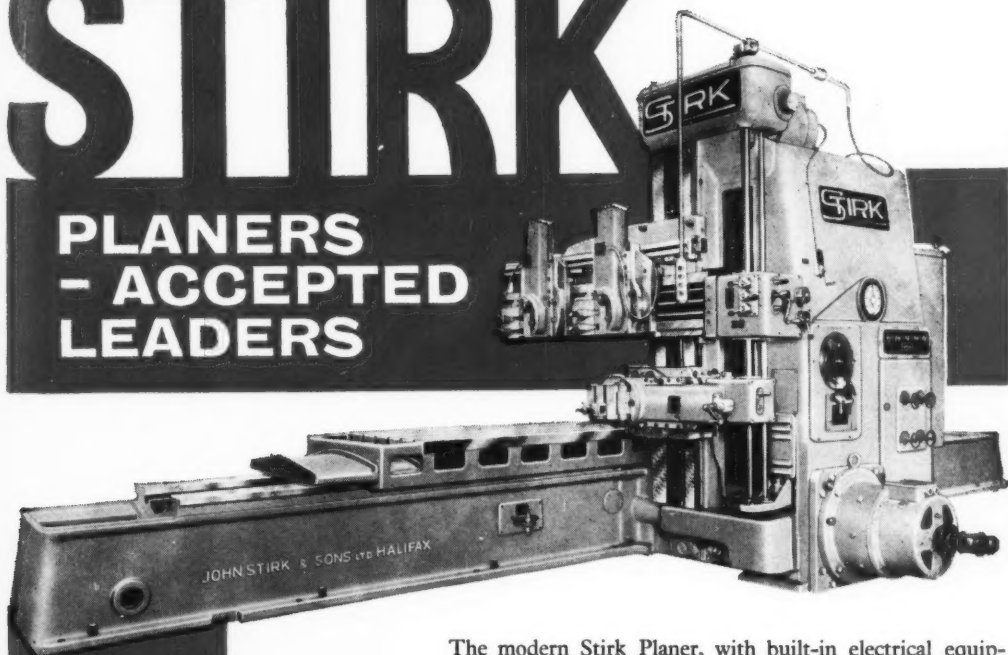
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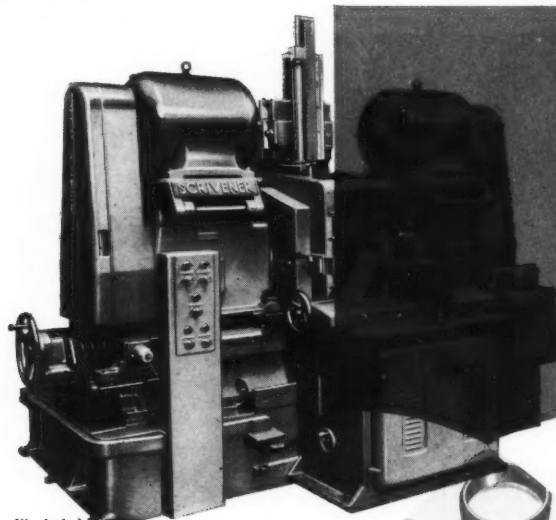
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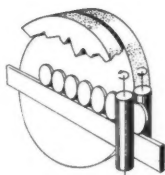


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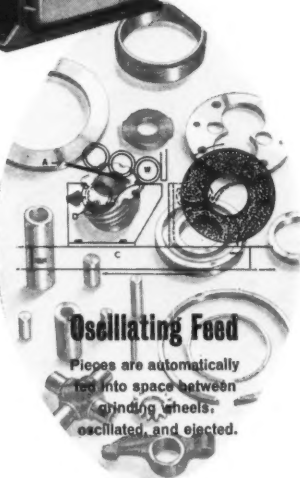
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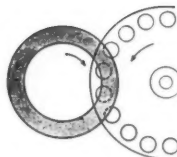
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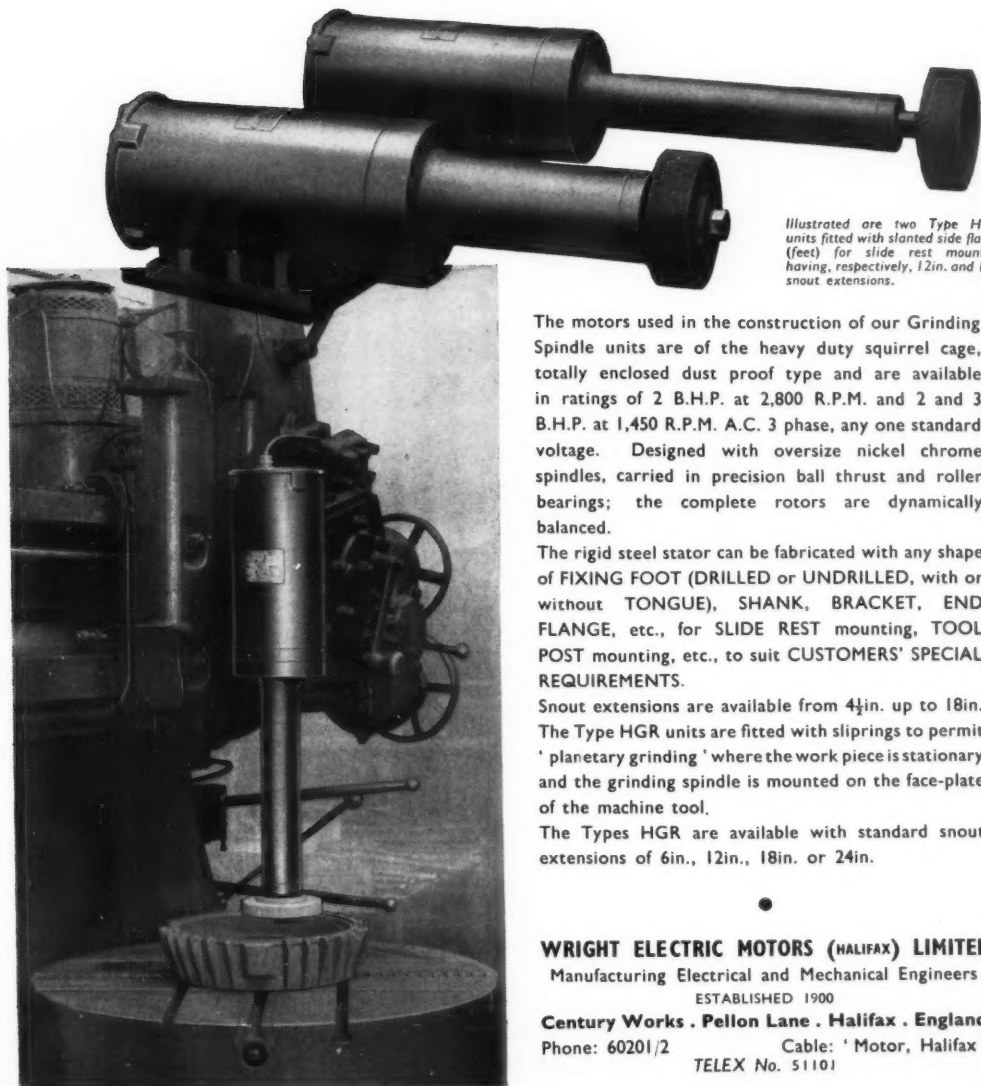
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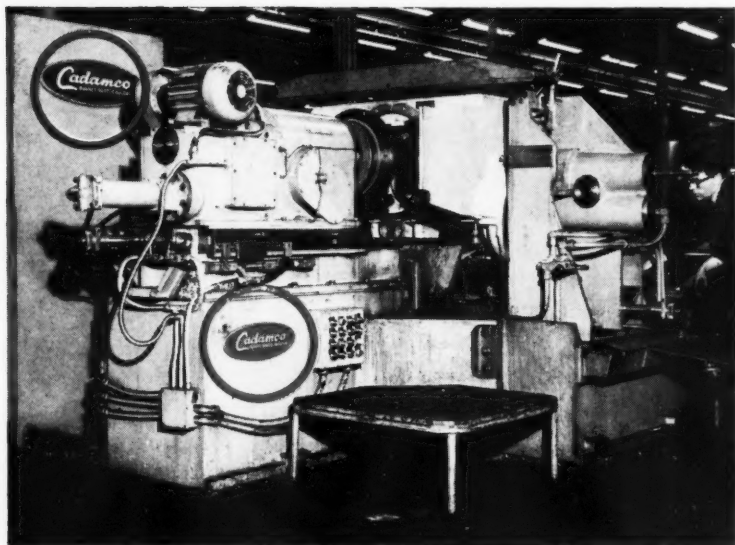


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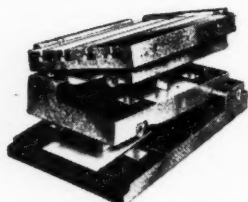
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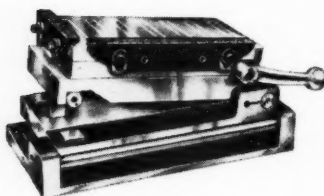
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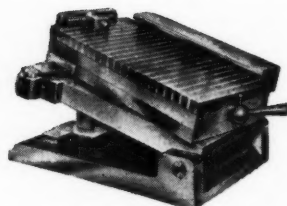




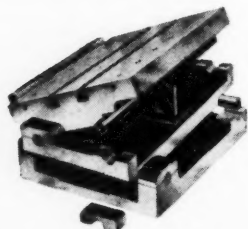
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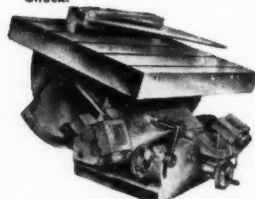
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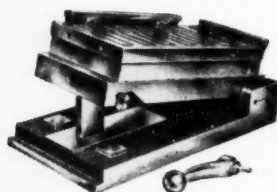
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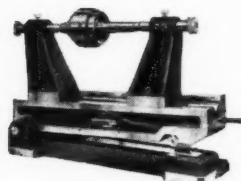
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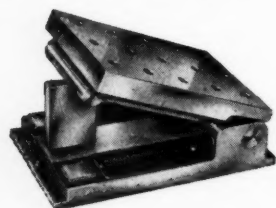
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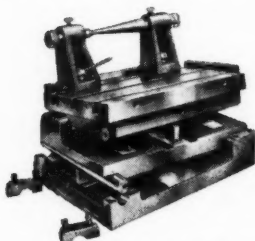


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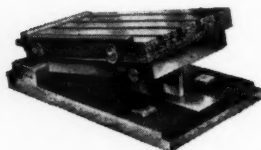


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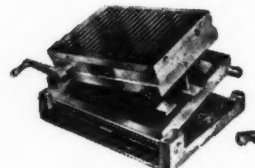
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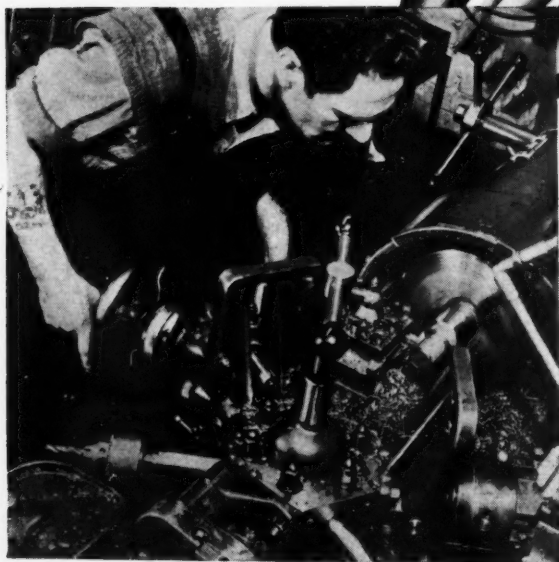
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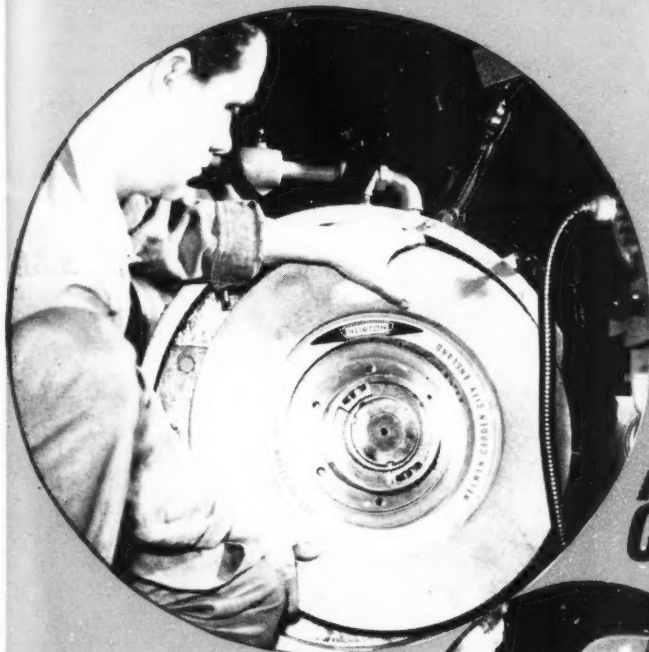




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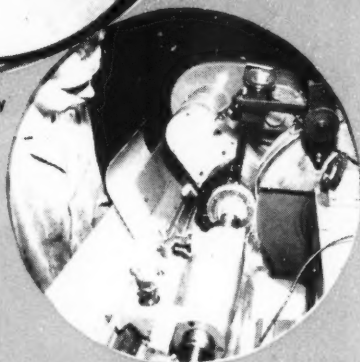


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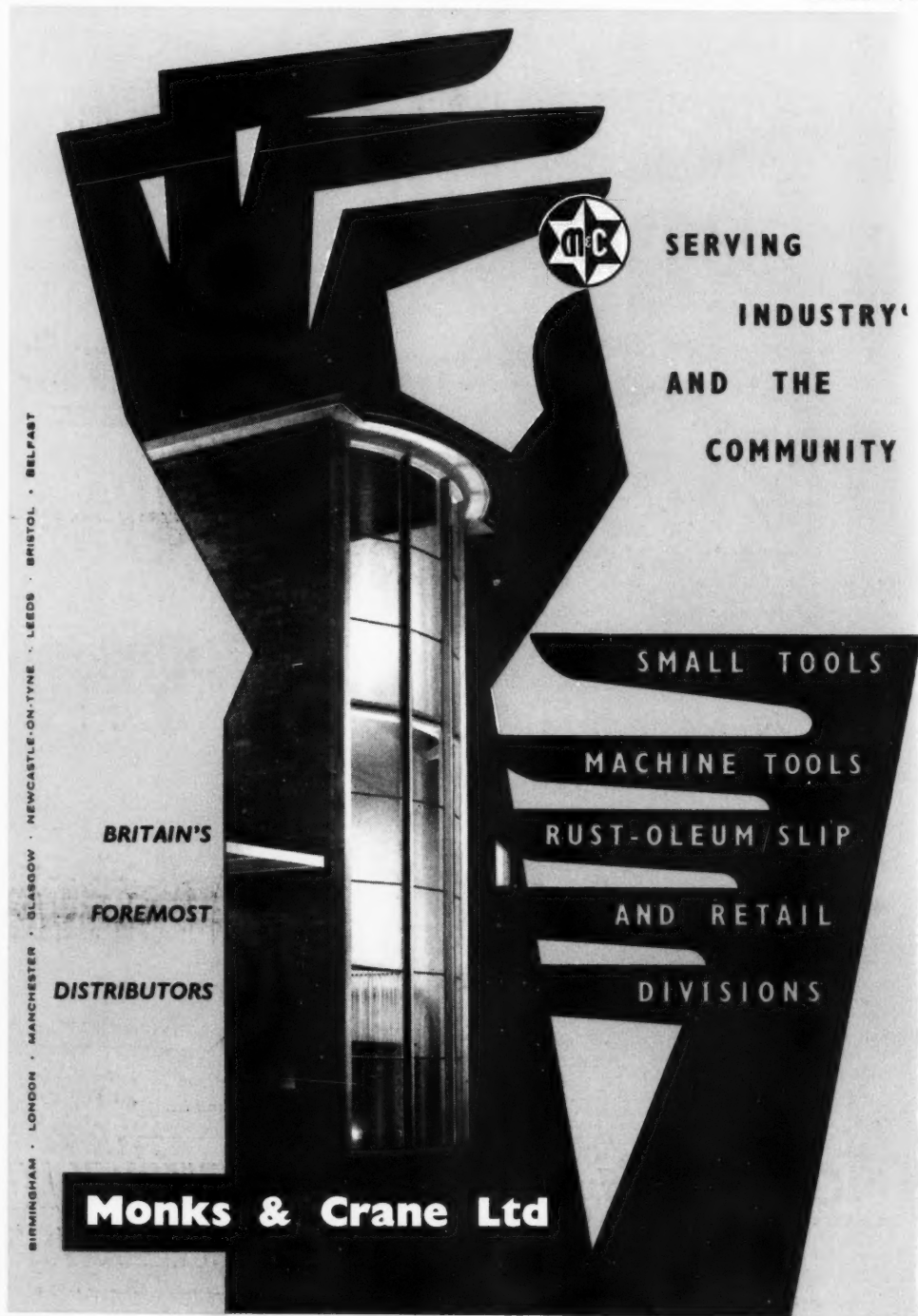
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A JOURNAL OF METAL-WORKING PRACTICE & MACHINE TOOLS

Vol. 99, No. 2551

October 4, 1961



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## Abstracts of Principal Articles

### Making the New, Type 35, Borg-Warner Automatic Transmission . . . P. 764

Extensions to the Letchworth factory of Borg-Warner, Ltd., during recent months to provide for the production of a new automatic transmission for motor cars have approximately doubled the capital investment in the plant, and nearly doubled the productive floor space. This article describes the design and operation of the new transmission, which incorporates a hydraulic torque converter and a three-speed epicyclic gearbox, and is intended for use with cars of 1.25 to 3 litres capacity. Details are then given of an impressive scale model of the entire factory floor, and of the methods employed in laying out the various machining lines. Among the operational sequences required for the production of the more intricate components of the transmission, those carried out on the pinion carrier are among the most interesting, and are described in the remainder of the article. The carrier comprises a cover member and a rear drum, which are machined separately and then assembled, and some interesting milling and facing operations are carried out on the drum component which is of intricate form. Certain finishing operations are performed after assembly, and the carriers are then inspected by means of an air-operated unit, and are tested for dynamic balance. (MACHINERY, 99-4/10/61.)

### Flash-welding Aluminium to Copper P. 790

The Synchronic system for flash-butt welding machines, supplemented by Dual Force auxiliary upsetting control, has been developed and patented by the Thomson Electric Welder Co., Lynn, Mass., U.S.A., and is stated to enable consistent results to be obtained. This article describes the system, and the equipment employed, and gives typical examples of flash-butt welding aluminium to copper. Sections as large as  $\frac{1}{2}$  in. by 6 in. can be joined, and parts which were subjected to a 180-deg. bending test showed no evidence of cracking. (MACHINERY, 99-4/10/61.)

### The Fencing of Dangerous Machinery

P. 793

The nature of an employer's duty to fence dangerous machinery has lately been considered during the hearing of two cases in the Queen's Bench Division. Although the two cases were in some respects similar, and the rights of the parties rested on the same

section of the 1937 Factories Act, the findings conflicted on an important point. The relevant facts of the cases are here described, and attention is drawn to the manner in which the verdicts differed. (MACHINERY, 99-4/10/61.)

### Automatic Drilling Unit for Operations on Long Contoured Panels . . . P. 806

An unusual automatic drilling machine is in use at the works of the Norair Division of Northrop Corporation, Hawthorne, Calif., U.S.A., for operations on large, contoured, sandwich-construction wing panels for laminar-flow control. The machine incorporates flexible slideways, which are clamped by vacuum to the surface of the panel, and take up the shape of the latter. Of the self-propelled type, the machine automatically indexes along the slideways to drill the holes in the required positions. A Tornetic computer regulates the amount of torque applied to the drill, by way of a feed-back circuit which is sensitive to the cutting conditions, and with this arrangement it is claimed that significant increases in tool life have been obtained. (MACHINERY, 99-4/10/61.)

### A Pneumatic Computer . . . P. 814

A model has been made by the British Hydro-mechanics Research Association, Harlow, Essex, to demonstrate the principle of operation of a pneumatic computer. The equipment incorporates two cylindrical chambers, sealed by diaphragms which are connected by a beam whereby two air jets are supported. Provision is made for varying three separate air pressures, and it is stated that by achieving a state of force balance, the equipment can be used for multiplication, division, squaring, and extracting square roots. (MACHINERY, 99-4/10/61.)

### Application of an NRC Electron Beam Welder in Bellows Production . . P. 815

Increases in the production of precision bellows ranging from 10 to 80 parts per hour are reported by the Metal Bellows Corporation, Wellesley, Mass., U.S.A., as a result of the successful application of a type 2405 electron beam welder supplied by the Vacuum Division of the National Research Corporation, Cambridge, Mass., U.S.A. The equipment can also be employed for electron beam brazing. (MACHINERY, 99-4/10/61.)

### Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

## EDITORIAL

## Improvements in Accuracy of Machine Tool Drives

On certain types of machine tools, an accurate relationship between two rotary motions or between a rotary and a linear motion is of critical importance, and whereas it is normally possible to provide for the required overall ratio between the two members without undue difficulty, on account of inevitable small imperfections in transmission members, relative uniformity between the motions cannot be achieved in practice. These remarks apply particularly to precision gear and thread cutting machines, and whereas progressive improvements have been made in the past in the accuracy of individual transmission components, with the result that irregularities of relative motion have been reduced to very small values, a point was reached where further advances in this direction presented problems of increasing magnitude. It is now coming to be accepted, therefore, that rather than attempt to produce gears, worms, worm-wheels, and screws to still higher degrees of precision, for incorporation in machine transmissions, it is better to accept the small residual errors that exist, and to superimpose corrective arrangements whereby their effects may be largely eliminated.

One method of achieving this result, to which attention has been previously drawn in *MACHINERY*, involves the use of so-called magnetic scales for comparing the relative speeds of rotation of a driving worm shaft and a machine table, for example. On the basis of the errors detected, a correction mechanism can then be produced for incorporation in the transmission, whereby the effects of the small inaccuracies in both the worm and the worm-wheel can be largely eliminated.

Another system was introduced as a result of collaboration between the National Engineering Laboratory and one of the leading British builders of hobbing machines, and in the recently issued Report of the Laboratory for 1960 it is stated that, when applied to a machine of 30 in. capacity, this system has enabled gears to be cut with tooth-spacing errors which are only one-quarter of those previously obtained. With this new method, glass discs with equally-spaced radial lines are employed, and the errors in relative movement of two rotating members are measured continuously by the moiré-fringe technique. On a hobbing machine, for example, the discs are applied to the work-table and to the table driving shaft, and optical reading heads are provided whereby the

rotary motions are converted into electrical signals. As a result, an output voltage which is proportional to the error in relative motion is fed to a servo-motor, and the rotation of the shaft is thus advanced or retarded to compensate for the errors.

This arrangement, it may be noted, provides for continuous compensation while the machine is in operation, in accordance with the conditions prevailing. It is anticipated, therefore, that it will be possible to cut gears to a high standard of precision throughout the life of a machine, since the results obtained will be determined by the graduated discs, which are not subject to wear, and not by the mechanical components of the transmission.

With a third system, which was demonstrated in connection with a hobbing machine displayed at the European Machine Tool Exhibition held recently in Brussels, continuous correction is again provided. We have not yet been able to obtain full details of this method, but we understand that the relative uniformity of rotation of the hob spindle and the work-table is directly monitored by an electronic system, and that correction is applied by means of a cam which is arranged to impart axial motion to the table driving worm.

In connection with the graduated glass disc arrangement mentioned above, further development work is being carried out with the object of ensuring improved accuracy, reliability, and versatility. With the system as originally applied, for example, certain restrictions were imposed by reason of the fact that it was necessary that the numbers of lines on the two discs should be in the same ratio as the speeds of rotation of the members to which they were attached. More recently, however, a method has been introduced whereby an electronic batching counter is employed in conjunction with two identical sets of scales. This method, to which reference is made in the N.E.L. Report, enables signals from the reading heads of different nominal frequencies to be compared, and will thus cover a range of reduction ratios.

It may also be noted that further work has been carried out in connection with a new method of producing master graduated discs or radial scales, as they are termed, to an accuracy within  $\pm 2$  sec. of arc. By this method, after a small segment

(Continued on page 825)





## Making the New, Type 35, Borg-Warner Automatic Transmission

By R. E. GREEN, Associate Editor

AN INCIDENTAL EFFECT of the recent introduction in the U.S.A. of so-called compact cars, as a result of which imports of cars of similar or smaller sizes from Europe have been considerably reduced, was a demand for smaller, lighter, and more efficient, automatic transmission units. Several such units have been put into production in America, most of which are smaller-sized developments of existing designs, and among them are included transmissions built by the Warner Gear Division of the Borg-Warner Corporation, at Muncie, Indiana.

Prior to the development of compact cars in the U.S.A., a factory had been set up at Letchworth, Herts., by the associated company, Borg-Warner, Ltd. Reference to this factory, and to some of the activities of the company has already been made in MACHINERY,\* and it may be noted that it was established partly on account of changes in manufacturing arrangements in the U.S.A., and partly because torque-transmission requirements were beginning to exceed the capacity of the unit which

was then in production. Europe offered a ready market for this existing fully-developed unit—the type 20 transmission—which was already well known here, and was being imported in small but growing numbers.

It was therefore decided to transfer the production of the transmission to this country, and a factory was built and equipped at a cost of some £4-million. Many of the special machine tools which had been developed in America for operations on transmission components were installed, together with considerable quantities of new British and German machine tools and equipment, and the factory was laid out to produce some 300 units per 8-hour day. With the advent of the American compact cars, and the smaller automatic transmissions which were produced for them, a demand has arisen for the incorporation of similar units in European cars that are exported to America. Partly for this reason, several British cars are soon to be equipped with the American-designed Borg-Warner type 35 unit, which will be produced in an enlarged factory at Letchworth.

\* MACHINERY, 02/1132—16/5/58, 03/120—16/7/58 and 03/632—17/9/58.



### THE TYPE 35 TRANSMISSION

When plans were being made for the production of a smaller transmission, with the needs of the European market in mind, car manufacturers here were asked which of the possible characteristics they would prefer. The final design, which was chosen by a majority of the companies concerned, is a 3-speed unit incorporating a hydraulic torque converter, and the value of orders in hand or anticipated has made it possible to plan for an output of some 400 units per shift, or 2,000 per week on a single-shift, 5-day week basis. In these circumstances, the price of the unit will be such that the car manufacturer should be able to include it in his specification at an extra cost of less than £100 to the customer.

The layout of the type 35 transmission can be seen from the cut-away side-elevation, Fig. 1. The bell housing, and any other castings which must be of modified forms to suit the requirements of particular motor car companies, are machined from aluminium alloy gravity die castings, so that variations can be introduced, as required, to suit the

attachment faces of the engines and the propeller shaft couplings. Within the bell housing is accommodated the hydraulic torque converter, and the transmission is designed for use with two alternative sizes of converters, with outside diameters of 9.5 and 11 in., for which bell housings of suitable dimensions are provided, the smaller size being shown in Fig. 1.

The smaller torque converter is intended for use with cars having engine capacities from 1.25 to 2 litres, and the larger, for cars of 2 to 3 litres approximately, although the power output of a particular engine will also exert some influence on the choice of size. Both units are of similar, 3-element design, and provide steplessly-variable torque multiplication in ratios from 1:1 to 2:1, according to engine and road speeds. The design of the converters is very similar to that of the units employed in the larger transmission, which was described in detail in the first of the articles to which reference has been made.

Each converter incorporates two bowl-shaped sheet metal pressings, and each pressing is provided with a number of curved vanes, which are held in

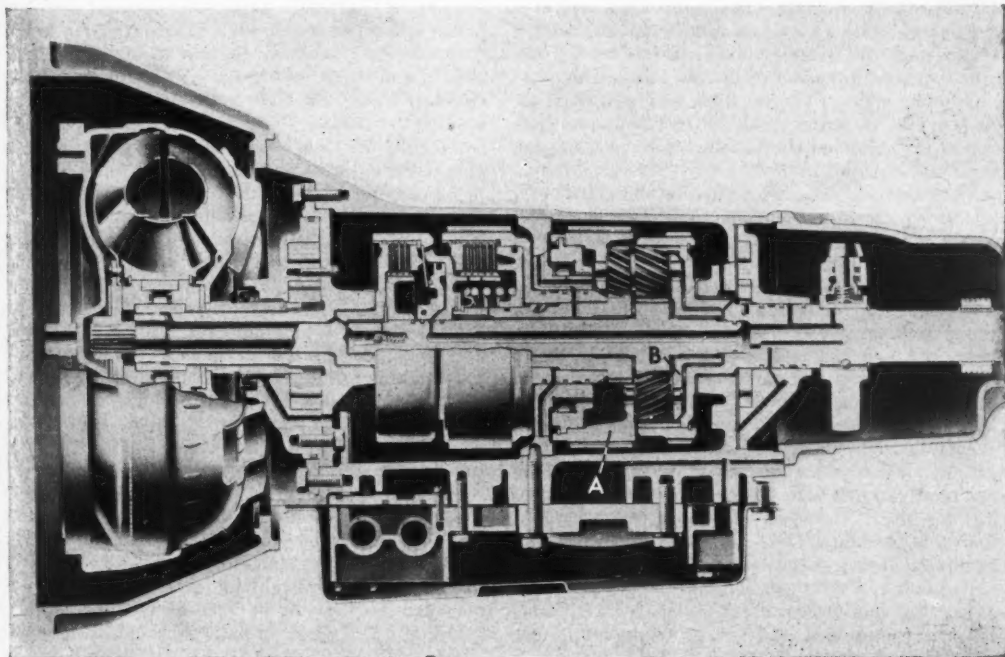
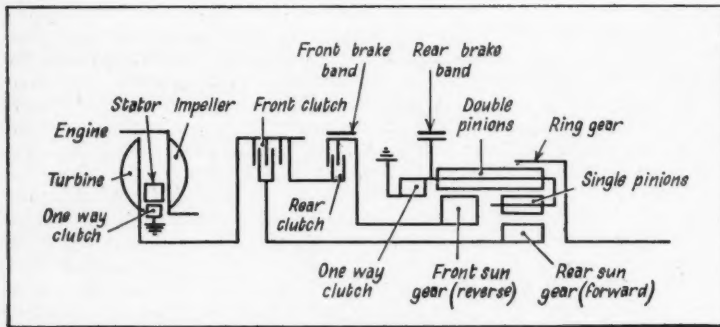


Fig. 1. This cut-away illustration of the new, type 35, Borg-Warner automatic transmission, shows the arrangement of the hydraulic torque converter, the magnetic clutches, and the epicyclic gearbox



**Fig. 2.** Diagram of the Borg-Warner automatic transmission showing the various elements through which the drive is transmitted from the engine to the rear axle of the car

place by locking tabs in slots during the preliminary stages of assembly. The vanes are braced by other annular pressings, of semi-circular section, the whole being copper-brazed to produce a very rigid assembly. Between the two bowls there is a pressure die cast stator of aluminium alloy, with a number of curved integral vanes, which is carried on a sprag-type one-way clutch or free-wheel unit on a fixed hub projecting from the case of the gearbox at the right. The impeller bowl is driven by the engine crankshaft, and the turbine, at the left in Fig. 1, is splined to the input shaft of the gearbox.

In operation, with the complete unit filled with oil at low pressure, any increase in the engine speed above idling, with the vehicle stationary, results in the application of centrifugal force to the oil, which is caused to leave the periphery of the impeller, enter the turbine and return between the stator vanes. The arrangement of the various vanes is such that oil is directed by the stator against the impeller vanes, so that it assists in driving the impeller, the torque multiplication effect mentioned above being thus obtained. With the vehicle stationary, the torque multiplication effect is reduced to nil when the turbine reaches approximately 90 per cent of the speed of the impeller. The angle of flow of the oil is then such that the stator is driven in the same direction as the impeller and turbine, and the complete converter acts as a fluid coupling.

In the larger transmission, a hydraulically-operated clutch was incorporated to provide direct drive through the transmission. Such a clutch is not provided in the smaller design, and the fluid coupling action is claimed to ensure smoother transmission of power and good flexibility when the

unit is employed with the small 4-cylinder engines for which it was designed, pick-up from low speeds in top gear being particularly good. From the turbine, power is transmitted to the double epicyclic gear mechanism through one of two hydraulically-operated, multi-disc clutches, which provide for forward or reverse drive. Hydraulic pressure for clutch operation and for other purposes is supplied by means of gear-type eccentric pumps at each

end of the gearbox portion of the transmission unit.

The very compact epicyclic gear train comprises two sun gears, a pinion carrier with three single and three double pinions, which are arranged to mesh in pairs, and a single ring gear, all the teeth being of helical involute form. In forward speeds, power is transmitted through the front clutch to the rear sun gear, and in reverse through the rear clutch and front sun gear. In addition to the clutches there are two brake bands, which are applied, by means of single-acting, spring-returned hydraulic cylinders in the gearbox, to smooth cylindrical surfaces on the pinion carrier and on a member connected to the front (reverse) sun gear, to select the various mechanical ratios provided. The pinion carrier also is mounted on a sprag-type, one-way clutch or free-wheel unit, which facilitates the selection of the required gear ratio.

For first, second and third gears, these ratios are 2.39, 1.45 and 1 to 1, and for reverse, 2.09 to 1, and they are selected by means of a completely self-contained hydraulic valve unit, which is built up from several pressure die castings of intricate internal form, and secured to the under-side of the gearbox casing within the oil sump. The road speeds at which gear changes are made are varied by means of a governor valve of the centrifugal type, driven from the output shaft of the gearbox, and a throttle valve is connected to the carburettor through a cable-operated cam. The pressure of the oil passing through this throttle valve is proportional to the engine torque and the vehicle speed, and it is directed to a main regulating valve which varies the line pressure, to ensure smooth gear changing under all operating conditions.

Changes in the valve settings are also obtained by means of the selector lever on the steering

column, which is marked L-D-N-R-P, standing for low, drive, neutral, reverse and park. In the last-mentioned position, a pawl is introduced between two teeth of a gear on the output shaft, and the supply of oil is cut off from the clutches so that engine power cannot be transmitted to the road wheels.

The functioning of the transmission can be more easily explained by reference to the simplified diagram in Fig. 2. With the selector in the low, or lock-up position, the front clutch is engaged to connect the converter output shaft to the rear sun gear and the rear brake band is applied to hold the pinion carrier stationary.

Power is then transmitted by way of the single pinions and the right-hand members of the double pinions to the ring gear which is secured to the output shaft, and a speed reduction of 2.39:1 is thus obtained, plus the reduction given by the torque converter. Meanwhile, the left-hand members of the double pinions drive the front sun gear freely, the direction of rotation being opposite to that of the rear sun gear. This setting serves to hold the transmission in low gear to ensure maximum engine braking when required.

When the drive position is selected, the setting is similar except that the brake band is released from the pinion carrier. The one-way clutch on which the latter is mounted prevents it from rotating clockwise, however, so that the lowest ratio is still engaged as the car starts from rest. As road speed increases, a change in the settings of the hydraulic valves takes place automatically, resulting in the application of the front brake band which serves to hold the front or reverse sun gear stationary.

With rotation of the pinion carrier, the gear train now gives a reduction of 1.45:1, exclusive of that of the torque converter. A further increase in road speed then re-sets the valves for top gear, both brakes being released and both clutches engaged to provide direct drive through the gearbox, the only reduction being that obtained from the torque converter.

In the neutral and park positions, no hydraulic fluid is supplied to the clutch or brake band operating mechanisms, and no power is transmitted. When the selector is moved to the reverse position, valves ensure the engagement of the rear clutch, with the result that the converter is connected with the front sun gear, and the rear brake band applied to hold the pinion carrier stationary. The drive is then taken through the double pinions to the output shaft ring gear, which is driven in the opposite direction at a reduction of 2.09:1, exclusive of the reduction that is provided by the torque converter.

## FACTORY EXPANSION

To provide for the supply of these transmissions to companies which are now preparing to fit them to their cars, the Borg-Warner company has embarked on a large-scale programme of expansion, whereby the size of the original factory has been doubled and a further 140,000 sq. ft. of productive floor space has been made available, together with space for all the necessary services. Since many of the components of the original (type 20) and the new (type 35) transmissions are of somewhat similar shape, many of the operations can be performed on common machine tools with slight changes of the set-ups. Instead of providing a completely new, self-contained plant in the extension therefore, the Borg-Warner planning staff was faced with the problem of integrating existing and newly purchased machines in many of the lines, to enable the plant to be used most economically, and to allow production of the earlier type 20 transmission to be continued.

## FACTORY MODEL USED IN PLANNING LAYOUT

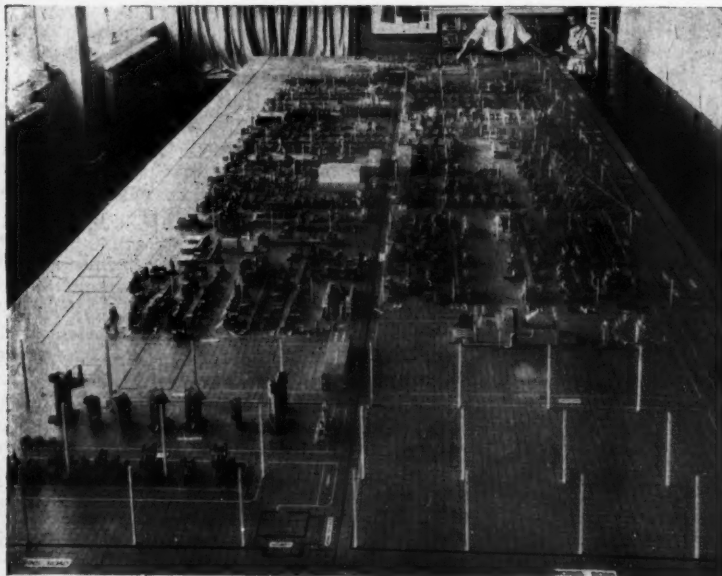
The original building occupied by the company was of rectangular shape, with a width of approximately 350 ft., and an area, including that occupied by the 2-storey office block located at one end, of 219,376 sq. ft. Of this area, the production departments accounted for some 175,000 sq. ft. to which, as indicated above, 140,000 sq. ft. has now been added. To assist in the relocation of the existing and the installation of the new machines in such a way as to ensure the most effective overall arrangement, a complete model of the factory layout was supplied by Visual Planning Systems, Ltd., at an overall cost of approximately £1,600.

A general view from one end is given in Fig. 3, and it may be noted that a large number of standard machine tool models from the ½ in. to 1 ft. range made by the company is included, in addition to various special models, to which further reference will be made. The production floor area of the factory, with the new extension, has dimensions of 350 by 888 ft., and is represented on the model by an area of 28 by 12 ft. which provides for a small margin all round. The office block at the end is not included. The model is arranged on a base-board, constructed in 16 sections, and has a main division which passes down the central longitudinal gangway of the factory.

As far as possible, the widths of the various supporting sections, which are located by steel dowels, were selected to conform to areas between various gangways on the shop floor, these areas

being devoted to the machining of different materials, including cast iron, steel and aluminium, or to heat-treatment or assembly operations. The object of this arrangement was to enable individual sections to be moved conveniently to facilitate access. In practice, however, it was found that all parts could be reached if the central division was kept open to provide a passageway. Boundary walls of the factory did not represent any serious obstruction and they have therefore been shown on the model merely by coloured lines.

Stanchions, however, must be considered at all planning stages, also the height limitations imposed by the roof trusses. Model stanchions, made from square-section extruded aluminium bar, are securely fixed in their correct positions, and each has a drilled hole in the top face to receive locating dowels on a roof section. Two types of roofing cover the old and the new portions of the factory, and a model section of each type was made, as seen at the left-centre of the close-up view in Fig. 4, in which the trusses are incorporated in detail. Each roof section can be mounted on any four adjacent stanchions within the appropriate area, to enable headroom to be accurately checked, and they are of particular value when methods of erecting tall machines are being planned.



**Fig. 3.** Produced at a cost of some £1,600, this complete model of the extended Borg-Warner plant at Letchworth proved invaluable in planning the rearrangement of old machines and the layout of new machining lines

#### **MACHINE TOOL AND PLANT MODELS**

As indicated above, many of the models of machine tools shown in Fig. 3 and 4, were taken from the standard range of more than 2,000 made by Visual Planning Systems, Ltd, but various models of special machine tools and other plant had to be specially constructed by them. For making the special models, recourse was had to measurement of the actual machines and other units where they were already installed in the factory, or to measurements provided by the suppliers. Over the period of 11 months during which the model was under construction, eight visits were made to the factory to measure existing installations and to discuss details of machine tools and plant on order.

The model incorporates some 2,000 separate items ranging from a single length of roller conveyor or a single model operator to a complete model of a Burr [George Kingsbury & Co. (Machine Tools), Ltd.] in-line transfer machine which will be 130 ft. long, and, when installed, will extend from one wall to the centre gangway of the factory, as seen in the right foreground in Fig. 4. Further reference to this machine, which will perform the complete series of operations on

the pressure die cast aluminium alloy transmission case, will be made in another article, to be published later. Of the 2,000 items mentioned, those specially constructed numbered about 380, and it may be noted that every installation in the heat treatment department had to be measured and drawn to scale before the model could be made.

Photographs taken with a Polaroid, self-printing, camera were supplied by Borg-Warner, Ltd., to enable details to be faithfully reproduced. Special models were checked for accuracy on receipt and a plant number was marked on an upper surface of each with Indian ink, and sealed with clear nail varnish. The model was then passed



to the planning engineer responsible for the section and a Tic-O-Tab adhesive label with a colour code and operation number was added. When a majority of the models for a given section was available, they were grouped on the layout board, and various arrangements were readily tried out in succession.

#### LAYOUT PLANNING OPERATIONS\*

The original Borg-Warner plant comprised some 500 machine tools, and for the production of the new transmission it was necessary to provide a further 500 machines and other items of plant. Installation of new machines and the rearrangement of the existing plant has deviated very little from the detailed programme which was originally drawn up with the aid of the model discussed above. The cost of the model represented less than 0.02 per cent of the expenditure for plant, and it is considered a very good investment.

Any plant layout is essentially a compromise, and after the positions of the main machining, heat treatment, assembly, and other areas have been established, and the overall flow pattern of materials has been laid down, there are almost innumerable possibilities for plant arrangement. In investigating these arrangements, models can be readily moved to provide completely different formations. At the same time, the planning engineer is continuously aware of the overall relationship between one machine and another, and even of the position of a part of one machine, such as a slide, relative to an adjacent unit.

This facility is not afforded by any other layout system, and the normal tendency is to decide on one of a limited number of formations because of the time and effort involved in starting again from the beginning. For the Borg-Warner model layout, a wheeled gantry was provided which could be

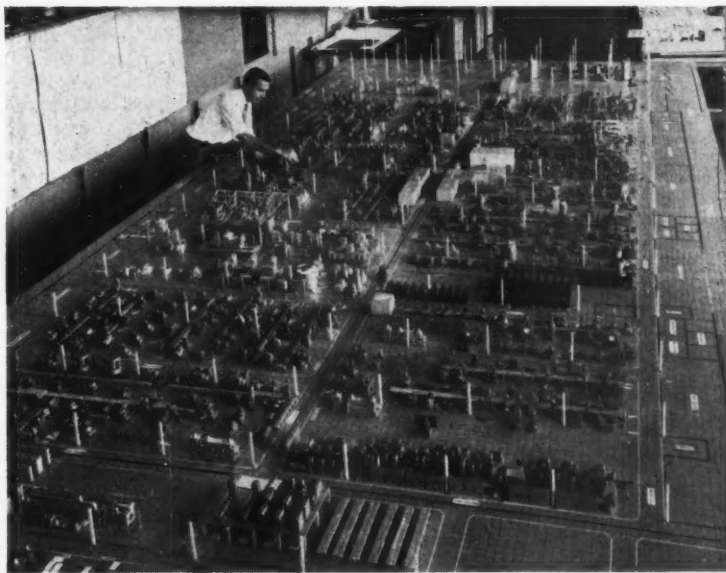


Fig. 4. In this view of the model layout, from the opposite end to that seen in Fig. 3, can be seen the model roof sections, employed for determining manoeuvring height available in various parts of the factory. The aluminium-machining area is seen in the right foreground

moved along to any position above the model and used to support a Polaroid camera at a suitable height. A photograph, from which a finished print was immediately available, could be taken of any trial arrangement of a machining line or area. An accurate record was thus provided, and it was possible to proceed immediately with the work of re-grouping.

When those concerned had decided that no further improvements could be made to the suggested arrangements, from the manufacturing standpoint, the best layout was easily selected from the photographs, and it was then possible to re-place the models in the agreed positions. A 2-dimensional plan of the layout was next made to a scale of  $\frac{1}{4}$  in. to 1 ft., with the aid of transparent plastics sheet, printed in  $\frac{1}{8}$ -in. squares, and film templates representing plan views of the machines. On these templates dotted lines showed the extent of slide movements and the spaces required by doors in the opened positions, and they were affixed with double-sided adhesive tape.

With the transparent plastics sheet used, the templates could be removed for repositioning if required, and each completed layout could also be printed by normal dye-line methods, an example

\* Much of the information under this heading is based on notes supplied by Mr. D. C. Donovan, Methods Engineer, Borg-Warner, Ltd.



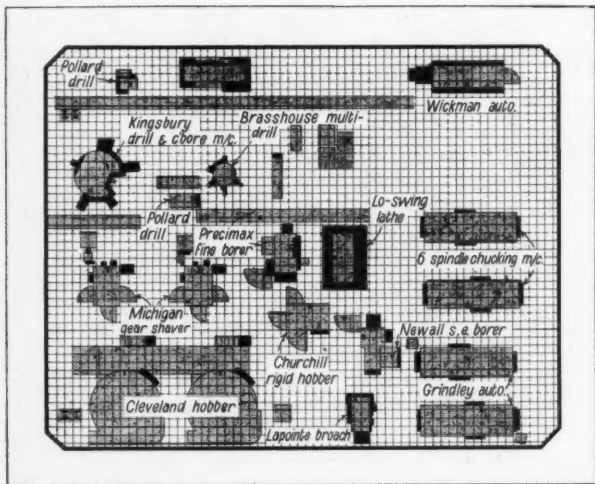


Fig. 5. The positions of the models in the layout shown in Fig. 3 and 4 were transferred to plastics sheets ruled with  $\frac{1}{4}$ -in. squares, to which plastics templates of the machines were affixed. From these sheets, working prints were made

of such a print being shown in Fig. 5. Plans could thus be supplied to the departments responsible for moving or installing the machines, and if a slight change were made in a layout it could quickly be shown on a modified print.

#### THE NEW FACTORY LAYOUT

At the end of the extension to the factory building, in the foreground in Fig. 3, an extra high, flat roof, supported on beams, is provided, having a ground clearance of 28 ft. 6 in., and extending for the full width. This area is covered by a travelling crane, and in the section to the left of the central gangway in Fig. 3 are installed presses and other sheet metal working machines for the production of parts for the hydraulic torque converter. For the present, the remaining area of this high-roofed portion is employed for raw material storage. Torque converter parts and raw material move from this end of the factory, the former to an adjacent assembly section equipped with welding machines and copper-brazing furnaces, and the latter through inspection and heat treatment areas to the machining sections.

A central gangway divides the remainder of the floor longitudinally, and on the side occupied by the press shop, beyond the torque converter assembly area mentioned, there is a section devoted

to the machining of the cast iron parts for the older (type 20) transmission (many of the operations were described in the articles published in 1958), and the Borg-Warner over-drive unit. Next, along the left-hand side of the building in Fig. 3, there are two departments, separated by a gangway, for machining various cast and malleable iron parts for both the old and the new transmissions. Next to the second of these iron machining areas there is a large tool store, represented by the rows of racks at the right in Fig. 4, in which all tools, except those for the press shop, are kept while not in use.

This tool store effectively separates the areas concerned with operations on iron parts from the department in which aluminium castings for both the old and the new types of transmission are to be machined, seen in the right foreground in Fig. 4. Most of the machines in the areas so far mentioned are arranged in flow lines across the width of the factory, with the input ends for raw materials on the wall side. Roller conveyors, and box-type and special pallets, are provided for the transfer of parts from one machine to the next, and the finished parts are delivered to the central gangway along which they travel to the finished parts stores or directly to the assembly shop.

Returning to the press shop end of the building, most of the space on the right-hand side of the central gangway in Fig. 3 is devoted to operations on steel components which are progressed through annealing and shot blasting departments to rough and semi-finish machining, gear-cutting, broaching, heat-treatment, and finish-grinding departments. Machines in these areas are arranged in flow lines as far as possible, for carrying out successive operations on such components as shafts. The finish-grinding area is situated approximately opposite the aluminium-machining area, and next to it—just visible in the foreground in Fig. 4—is the stores for bought-out components and finished parts, those for the different sizes of transmission being stored separately.

Parts from these stores are issued to the adjacent assembly area, which is totally enclosed and is slightly pressurized to exclude dust from the main shop, which might contaminate the hydraulic systems during assembly. In this area, continuously-moving conveyors are provided on which the transmissions are built up as they travel along on

special platens to the dynamometer test benches. All assemblies are dynamometer tested, and an area is provided for the rectification of any faults that may be detected. The fitting of torque converter assemblies, and housings and extension pieces to suit the particular vehicles in which the transmissions are to be incorporated, is also carried out in this area.

#### OPERATIONS ON PINION CARRIERS

The pinion carrier, in which three single and three double pinions are mounted, is assembled from two parts, known as the rear drum and the planet cover, and indicated at A and B respectively in Fig. 1. After preliminary machining, the two parts are fastened together with three rivets, and finishing operations are then carried out on the assembly. A drawing showing the layout of the machines for operations on the rear drum and planet cover, and on the assembly, is shown in Fig. 6, and was prepared from a print similar to that of Fig. 5. The machines in the line are arranged in pairs as far as possible, so that two can be tended by one operator, and loading stations on such machines are placed near to or opposite each other, for convenience. The finishing end of the line is seen in the heading illustration.

When planning the tooling for many of the machines, provision was made for a cycle time of the order of 1 min., to enable the required output of 50 transmissions per hour to be maintained, with an allowance for setting and other contingencies. Clamped tip tools are employed wherever practicable, to save setting time. Indexing or replacement of the tips is performed by the operators whenever gauges show that the permitted limits are being approached.

End elevation and sectional views of the finished cover component of the pinion carrier assembly, which is machined from a pearlitic malleable iron casting, are shown in Fig. 7. The first operations on this casting, which is in the shape of a flanged tube with an outside diameter of  $4\frac{1}{4}$  in. are carried out on an 8-spindle New Britain-Gridley chucking automatic installed at C in Fig. 6, and a view of the set-up on this machine is given in Fig. 8. The automatic formed part of the original equipment of the factory, and, together with several of the other machines in the line, is also employed for similar operations on components for the larger transmission.

The cover casting is held by the unmachined boss in special attachments on the three jaws of the air-operated chucks, faces on these attachments providing for axial location, and loading is performed during the machining cycle at the station seen in

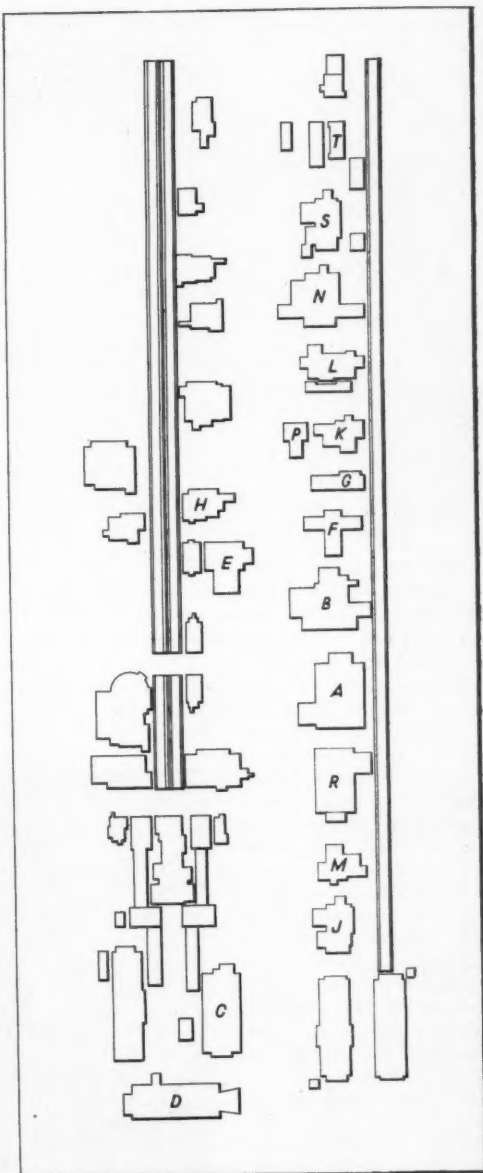


Fig. 6. This drawing, prepared from a print similar to that shown in Fig. 5, indicates the positions of the machines employed for operations on the two parts of the pinion carrier, and on the complete unit after assembly

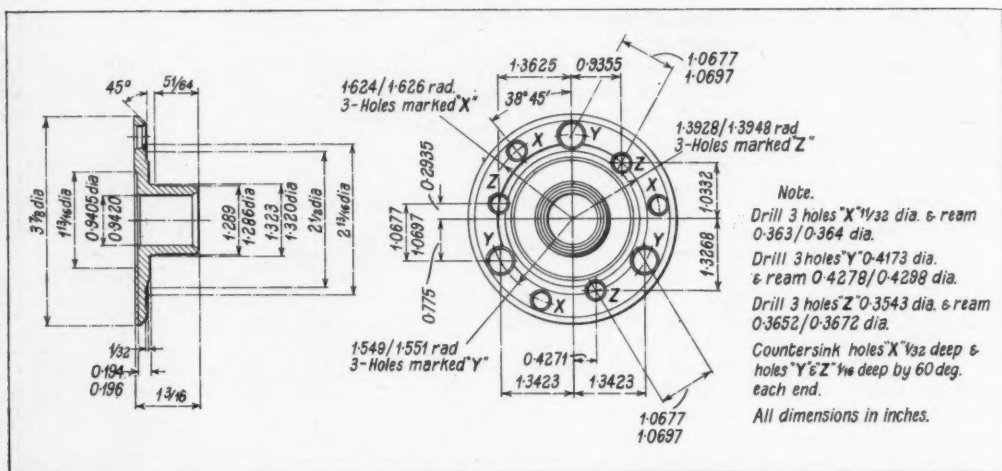


Fig. 7. Views of the cover portion of the pinion carrier, prior to assembly. This component is machined from a malleable-iron casting on part of a line which is also employed for the production of similar parts for the larger, type 20 transmission

line with the empty turret position. When the spindle drum is indexed, the freshly-loaded casting is carried downwards to the first machining station where a 2-lipped, carbide-tipped core drill is employed to open out the central hole.

A swivelling tool-holder at the side, at this station, carries a Kendex [Kennametal (Great Britain), Ltd.] clamped-tip, throw-away type tool-holder with a triangular tip, which is fed part-way across the face during the drilling operation. Another similar core drill at the second machining station further enlarges the central hole, and the bracket also carries a Kendex holder with a square tip which is plunge fed into the flange edge to produce the deep 45-deg. chamfer shown on the drawing. The centre hole is again enlarged at the third station by a tool on the main slide, which also carries a Kendex

holder with a triangular tip for turning the outside of the flange.

A single point tool rough-turns the bore from the main slide at the fourth position and a swivelling tool-carrier is provided with a Kendex tool for semi-finishing the face of the flange, also a brazed-

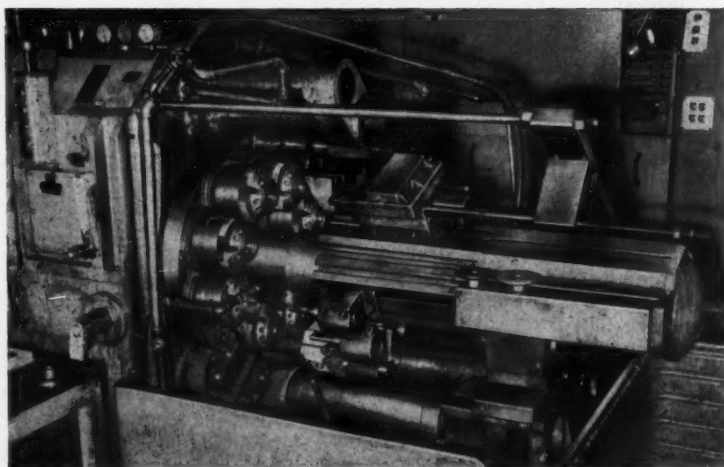


Fig. 8. Preliminary operations on the cover casting are performed on this 8-spindle New Britain-Gridley chucking automatic. Kennametal Kendex clamped-tip tools with indexable, throw-away tips are widely employed

tip tool for chamfering the rear edge on the chuck side. Two tools in a boring bar at the fifth position bore the central hole and chamfer the end, and the flange face is turned by a Kendex triangular tip on a swivelling holder. Two carbide-tipped tools in a special holder on the main slide at the sixth position are plunge-fed into the face surrounding the bore to produce the recess shown in the drawing, leaving metal for a finishing operation. The chamfer on the flange is finish-machined with a tool on the main slide at the seventh station and the casting is subsequently unloaded. A spindle speed of 273 r.p.m. is employed, with feeds ranging from 0.004 to 0.073 in. per rev. for these operations.

Machining of the hub-side of the casting is next performed on a B.S.A. Acme-Gridley (Burton, Griffiths & Co., Ltd.), 6-spindle, 6-in. capacity, chucking automatic, indicated at *D* in Fig. 6, the 3-jaw chucks being fitted with special recessed attachments to grip the periphery of the flange. A view showing some of the tooling is given in Fig. 9, where the loading position is seen at the centre, and the spindle drum carries the component downwards to the first station. Here, main slide tools, of the brazed tip type turn the outside of the hub, and plunge face the end. These tools are mounted in a holder of special design, which also carries a Sandvik Coromant clamped-tip tool to chamfer the end of the boss.

A cross-slide holder at this position is equipped with a Coromant tool which rough-faces the

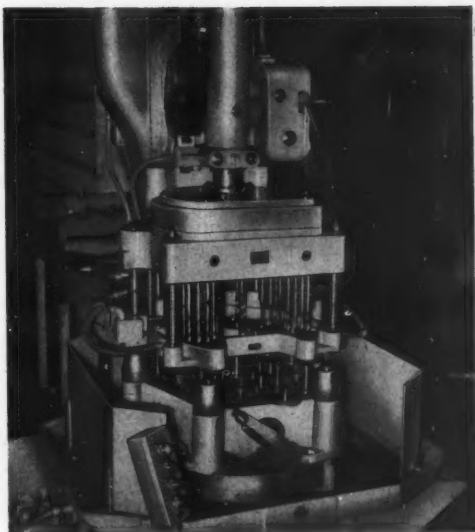


Fig. 10. Drilling, reaming and chamfering operations on the nine holes in the cover are carried out on this Pollard multi-spindle drill. Each casting makes two circuits of the table

flange almost up to the hub. These operations are repeated, with lighter cuts, at the second machining position, and at the third, there is another special tool holder with two brazed-tip tools which operate in the bore, and on the flange face to produce the  $\frac{1}{8}$  by  $\frac{1}{8}$  in. recess. A brazed-tip tool on the cross-slide faces the flange at this position. At the fourth spindle station, a turret tool chamfers the end of the bore, and at the fifth, seen at the top in Fig. 9, the main slide carries an adjustable carbide-tipped reamer which semi-finishes the bore, leaving a small amount of material for fine boring.

The cross-slide at this last machining position carries a skiving tool, and a bracket to support the work on the opposite side, and this tool is employed to finish the hub to 1.320/1.323 in. diameter. On this machine the spindle speed is 400 r.p.m., and feed rates vary from 0.0016 to 0.0072 in. per rev. Both these machines operate within the 1 min. cycle time mentioned previously, and with the high cutting speeds made possible by the

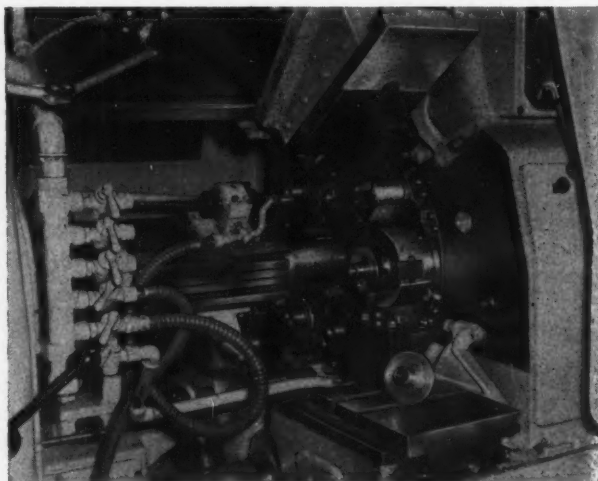
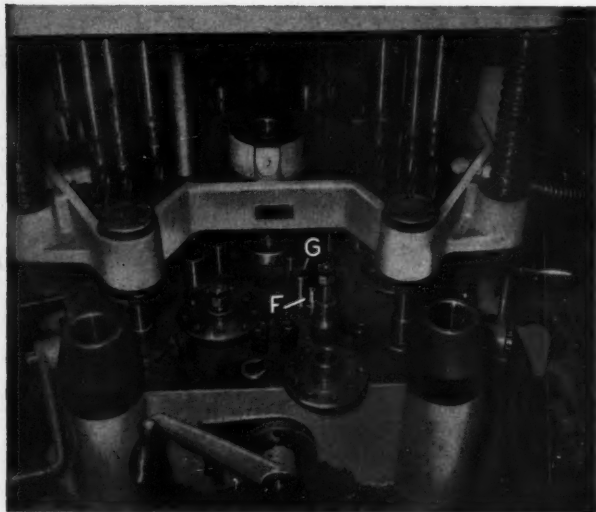


Fig. 9. The hub side of the cover casting is machined on this B.S.A. Acme-Gridley 6-spindle automatic on which Coromant clamped-tip tools are used wherever possible





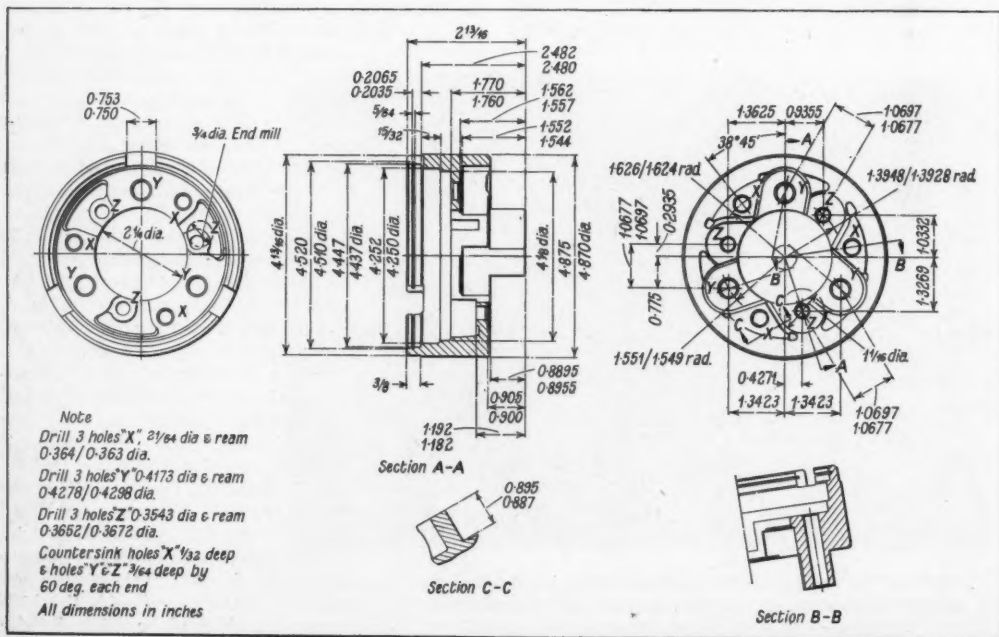
**Fig. 12 (below).** Views of the rear drum component of the pinion carrier assembly, which has nine holes in similar positions to those in the cover, for the rivets and pinion shafts

**Fig. 11.** A close-up view of the fixtures on the Pollard drilling machine showing the method of clamping the cover castings by means of draw-bars, which are pulled down by a lever at the front of each pair of fixtures

use of carbide tooling, the chips are too hot to permit the use of cutting oils. It was found that with such oils excessive smoke was produced, and recourse was therefore had to Hocut J soluble oil, supplied by Edgar Vaughan & Co., Ltd., diluted 30 to 1 with water.

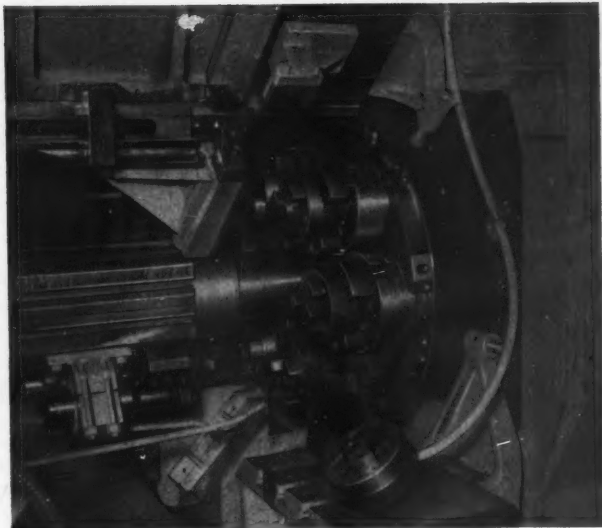
#### DRILLING, REAMING, CHAMFERING AND FINE-BORING OPERATIONS

After being unloaded from the second chucking machine, the parts are placed in a box stillage for subsequent transfer to the Pollard automatic multi-spindle drill, indicated at E in Fig. 6. This machine was supplied in the fully-tooled condi-





**Fig. 13.** A pair of B.S.A. Acme-Gridley, 7½-in. capacity, 6-spindle chucking automatics is employed for roughing operations on the front and rear faces of the rear drum. The set-up for the first operation is shown here



tion, as shown in Fig. 10, and operates on an automatic cycle, initiated by push-button, during which the head is lowered by a cam at the left of the column. The driving motor for this cam is stopped after it has completed one revolution, by the operation of a micro-switch.

The 5-position indexing table is turned by hand, and is approximately located in the required positions by a spring-loaded detent. Cylindrical pins on the multi-spindle head provide for accurate positioning of the table as the tools approach the work. A close-up view in Fig. 11 shows details of the tooling, and there is a right- and a left-hand clamping position at each station. Clamping is effected by means of the lever at the front, which pulls down a central draw-bar at each clamping position, force being applied through a C-washer to the central portion of each component. A fresh part is loaded at the left-hand side first, on which it is supported on three pads, and after making a circuit of the table the partly-machined component is removed and reloaded in the inverted position at the right-hand side.

This procedure enables both ends of the drilled holes to be chamfered, and it also enables the work to be distributed among a larger number of spindles than would be possible if the component made only one circuit of the table. The operations performed include drilling and chamfering all the nine holes shown in Fig. 7, finish-reaming the three rivet holes Z, and semi-finish reaming the six pinion shaft holes X and Y. For the second circuit, the component is located angularly from one of the pinion holes drilled during the first circuit, which is engaged with a disappearing dowel F, Fig. 11. At positions at which machining is to be performed on the hole engaged by the dowel, the latter is depressed by means of a projecting pin on the bush plate as the tools approach the work. The pin makes contact with the end of a spring-loaded plunger G, which is connected to the dowel beneath the fixture top plate.

Castings on which the drilling machine opera-

tions have been completed are loaded, two at a time, on expanding mandrels fitted to a 2-spindle Ex-Cell-O fine-boring machine, indicated at H, in Fig. 6. Two tools, carried in a removable holder, operate on each casting on this machine, to face the flange and the central recess on the side opposite to the hub, and the covers are then ready for assembly to the rear drum components.

#### OPERATIONS ON THE REAR DRUM

The rear drum is also machined from a pearlitic malleable iron casting, and a drawing giving the finished dimensions is shown in Fig. 12, from which it will be noted that the component is of intricate form with six pockets to hold the single and double pinions. Operations on this component, which does not resemble any of the parts employed in the older transmission, are carried out on the line at the right in Fig. 6, the first two machines—at the bottom in the illustration—being B.S.A. Acme-Gridley, 6-spindle automatics of 7½ in. chucking capacity. These two machines are arranged face to face for loading and unloading by one operator, and are tooled to carry out roughing operations on opposite ends of the castings in succession.

A view of the tooling on the first machine is given in Fig. 13, and the casting is gripped in special jaws on the end opposite to that which has the three triangular lugs. On both machines Sandvik Coromant throw-away, clamped-tip tools are employed wherever possible. The spindle



**Fig. 14.** The outside of the drum is fine turned, and the ends are faced to establish datum surfaces for subsequent operations, on this Landis-Lund Precimax machine. A sub-slide on the table provides for retraction of the tools to avoid scoring the finished drum surfaces

speed is 308 r.p.m., with feeds ranging from 0.0039 to 0.007 in. per rev., and Hocut J soluble oil is used as before. Operations performed at the set-up shown in Fig. 13 include rough-boring and rough-turning the lugs from the main slide and facing from the cross-slide, at the first machining position. Core-drilling of the main bore from the main slide, with a brazed tool provided with a very heavy carbide insert, and chamfering from the cross-slide follow at the second position; and at the third, tools on the main slide part-turn the outside and machine the main bore while a tool on the cross-slide faces the lugs.

Further turning on the outside diameter is carried out at the fourth position, from the main slide, while another cross-slide takes a second facing cut on the lugs, and at the fifth position the bore is finished from the main slide. On the second automatic of the pair, the casting is gripped on the previously-machined diameter, for turning, boring and facing operations on the plain end. An internal facing operation is carried out with a radially-moving tool on the main slide, which is advanced into position before being moved sideways by a pusher on the cross-slide at the fifth machining station.

#### **FINE-TURNING -FACING AND -CHAMFERING OPERATIONS**

Fine-turning of the external surface, to produce the smooth finish required on the outside of the drum, to which the brake band mentioned earlier

is applied, also facing and chamfering operations, are next carried out on two components at a time on the Precimax (Landis-Lund, Ltd.) fine-boring machine at *J* in Fig. 6, the set-up being shown in Fig. 14. The two spindles of this machine are driven at 392 r.p.m., and each carries a Pratt air-operated expanding chuck with special jaws which grip the bore of the part. The normal table movement, parallel to the spindle axes, is employed for the fine-turning operation, with a feed rate of 0.005 in. per rev., to produce a surface having maximum irregularities with-

in the limits of 30 to 50 micro-inches specified by the design office.

The table is also fitted with a hydraulically-operated cross-slide, on which the tools are mounted, to provide for facing motions at 90 deg. to the direction of traverse. For the fine-turning operations, the cross-slide carries two tool-holders *K*, each of which is equipped with two tools. One of these tools is employed for the turning operation for which the table is fed to a stop. Two more tool-holders *L*, have U-shaped cut-outs on the left-hand sides, which are brought into position opposite the castings at the end of the turning feed movement. In each cut-out there are four tools, two of which are arranged to face the front and rear of the drum, and two to chamfer the edges, when the cross-slide is fed to the left by means of a hydraulic cylinder at the right-hand end. The second tool in each of the holders *K* is brought into contact with the edge of the bore of each casting, towards the end of the slide movement, to produce an internal chamfer.

Because it is specified that the braking surface of the drum shall be smooth and free from tool marks, it is necessary to ensure that the turning tools are clear of the work surfaces during the withdrawal movement of the table. For this reason, the tool slide is of multiple construction, comprising two slides, one above the other, which are operated by separate hydraulic cylinders arranged in tandem at the right-hand end. The ram of the smaller cylinder, nearer to the tools, is connected to the upper slide, and provides for the

facing and chamfering movements of the tools and for their return in the lateral direction.

When the tools have been withdrawn to the right, the second, larger hydraulic cylinder is energized as a result of the operation of one of the micro-switches shown, by a stop on a bar secured to the upper slide. The ram of this cylinder acts through a bell-crank lever beneath the tool slides to move the lower slide through a distance of 0.010 in. to the right, to bring the fine-turning tools clear of the work surfaces. After the table has been retracted, the oil supply to the larger cylinder is reversed, to return the tool slide to its original position, in readiness for the next turning operation.

#### **FINE-BORING, RECESSING AND CHAMFERING OPERATIONS**

The next machine in the line, at M in Fig. 6, is an Ex-Cell-O fine-borer, which performs operations on two internal diameters, faces the end, and plunge-cuts the  $\frac{1}{8}$ -in. wide recess in the plain end, on two castings at a time. A view of the set-up is given in Fig. 15, and each casting is held on the finished brake drum diameter in a Woodworth, air-operated diaphragm chuck, made under licence in this country by F. Pratt & Co., Ltd. The chuck has six jaws, each fitted with a clamping piece, the bore of which is part of a circle of the same diameter as the brake drum, and each jaw has a datum face against which the rear face, turned at the previous operation, is pressed during loading, to ensure accurate axial location.

Each of the two similar tool-holders carries five tools, of which three operate on the bore to finish the outer diameter and the adjacent 4.250 / 4.252-in. diameter for the sprag-type one-way clutch assembly, and to chamfer the shoulder. These tools are applied by the axial movement of the table at 0.003 in. per rev., with the spindles running at 320 r.p.m. At the end of the in-feed motion, the slide carrying the tool-holders is moved to the left to bring the

facing and groove-cutting tools into operation. The depth of the groove, which houses a retaining circlip for the sprag-type clutch in the final assembly, is held to 0.073/0.083 in., and the tools are withdrawn by reversal of the original feed motions.

A "go" and "not-go" gauge N, supplied by Yorkshire Precision Gauges, Ltd., is employed for checking the groove width. This gauge takes the form of a part-circular plate which fits into the outer bore of the component. The plate is in two parts, secured together by screws, with a slot in which a measuring element is accommodated. With the gauge in position, the measuring element, which is made to the high and low width limits at opposite ends, is pushed first to one side and then the other. Concentricity between the outside diameter and the bore for the sprag-type clutch must be held to a total indicator reading of 0.002 in., and is checked by the gauge P, made by Macdonald Tools, Ltd., Coventry, which has a V-grooved portion to support the outside diameter.

A lever projects through a fence at one side of this V-grooved portion, and is held in contact with the plunger of a Baty dial indicator graduated in 0.0001 in. divisions. When the component is placed in position on the V-faces, the lever is in contact with the clutch bore, and errors of concentricity are shown when the part is turned. One operator tends both the fine-boring machines just described, and the parts are transported on a roller



**Fig. 15.** Woodworth diaphragm chucks are provided on this Ex-Cell-O fine boring machine to hold two rear drums on the finished outside diameter, for boring, facing and recessing operations on the plain end

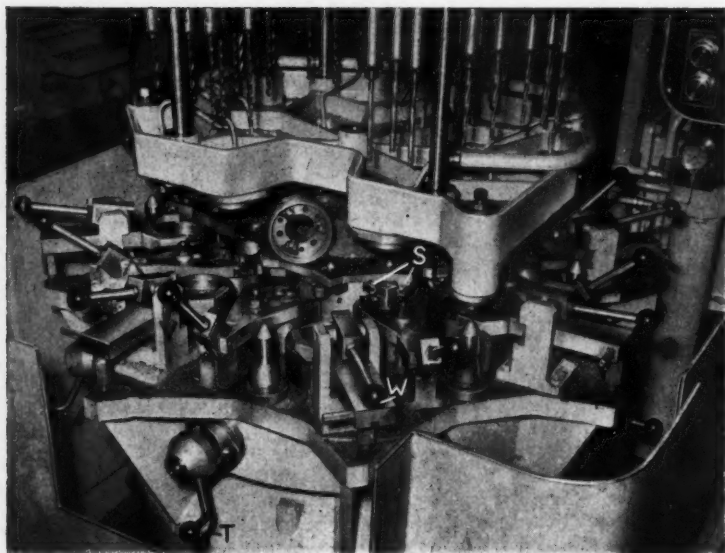


Fig. 16. Close-up view of the fixtures and tooling on the Archdale multi-spindle machine employed for drilling, reaming, chamfering and spot-facing operations on the nine rivet and pinion-shaft holes in the rear drum

conveyor to the next pair of machines in the lines, which are also tended by one operator, and are arranged facing inwards.

#### ARCHDALE DRILLING AND REAMING MACHINE

The Archdale drilling and reaming machine, indicated at R in Fig. 6, on which the parts are next loaded, performs a series of operations somewhat similar to those carried out on the Pollard machine described earlier, but is of considerably heavier construction because of the increased thickness of metal to be drilled. A view of the machine is given in Fig. 16, and the table carries an eight-station indexing fixture, each station having two clamping positions, one near the centre and one near the edge of the table. A fresh casting is loaded first in the position nearer to the centre, with the finish-turned plain end engaged in a register. Angular location of the casting is obtained from one of the lugs, which is engaged by hardened, serrated jaws S, drawn together by turning the handle T, one of these handles being provided for each station.

A centre-pivoted lever-type clamp, with a forked end and pads whereby clamping force is applied to the face of the casting outside the lugs, is then advanced into position above the casting by means of the handle V, which is pivoted and carries a cam at its lower end. The cam moves in a groove in a rectangular post, and the handle is subsequently swung downwards, towards the operator, to raise the outer end of the lever and apply the clamping

force to the component. After making a complete circuit of the table, during which all the nine holes X, Y and Z, Fig. 12, are drilled and chamfered at one side, and most of them are reamed, the casting is unloaded, inverted, and re-loaded at the table edge.

In this position, the casting is located by a dowel in one of the holes reamed during the first circuit, and by a register which engages the outside of the drum. Clamping is effected by means of a sliding member with a forked end which engages the plain end of the casting at opposite sides, force being applied by a cam, turned by the lever W, after the clamp has been moved by hand into the position shown. During the second circuit of the machine, reaming and chamfering are completed. In addition,  $\frac{3}{8}$ -in. diameter end mills are applied to spot face areas near the three holes Z, Fig. 12, for the short, single-pinion shafts, as shown in the view on the left. It may be noted that on this machine the three rivet holes X, Fig. 12, are finished to size, but material is left in the remaining holes for removal by line boring at a later stage.

#### MILLING THE PINION RECESSES

To provide clearances for the two sets of pinions, the recesses in which they are to be accommodated are next machined with end milling cutters of  $1\frac{1}{8}$ -in. diameter on the special Archdale machine, at A in Fig. 6. Basically a heavy-duty multi-spindle drilling machine of similar design to that in Fig. 16, this unit, which is shown in Fig. 17, is provided with a 12-station indexing fixture, carried on guide-ways extending towards the loading position at the right. The head has six spindles, each fitted with an end mill of appropriate length to suit the depth of the recess to be machined. During the automatic



**Fig. 17.** Six pinion recesses are milled on this Archdale machine which has a table equipped with 12 fixtures. After lowering the head to engage the cutters with the work, the table is traversed hydraulically towards the operator to mill the recesses

cycle, the head is lowered to depth by means of external hydraulic cylinders, a guide bush at each side being engaged with a heavy section cylindrical pin held in a substantial bracket on the machine base.

With the head in the lowered position, the table is fed towards the operator by a horizontal hydraulic cylinder at each side, up to a fixed stop, and during this time the two fixtures at the front of the table are unloaded and loaded with fresh parts. As the table is advanced, the workpieces are fed against the cutters which were lowered into the central spaces. After completion of the feed movement, the head rises, the table is indexed, and the cycle repeated. Fig. 18 gives a close-up view, and it will be seen that all the fixtures are of similar design, each having a sliding clamp and cam lock like those for the outer ring of fixtures on the drilling machine in Fig. 16. Location, however, is taken from the one-way clutch bore instead of the outside diameter, and each part is located angularly by one of the finish-reamed rivet holes, which is engaged by a fixed dowel in the fixture.

The positions and shapes of the recesses to be machined are shown in the right-hand view in

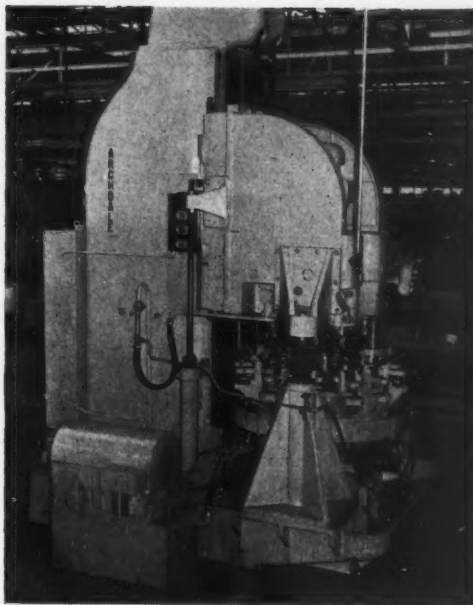
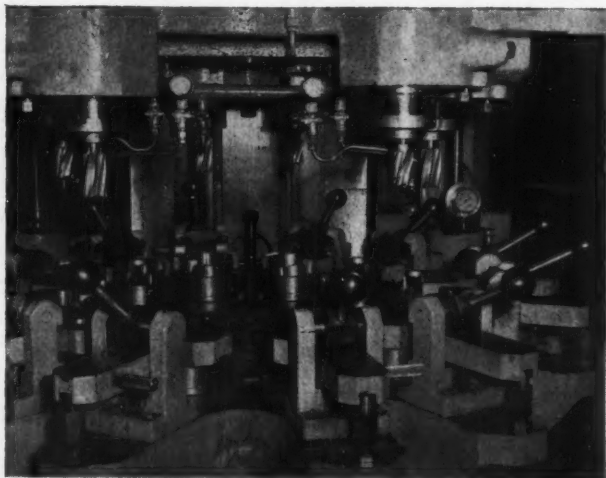


Fig. 12, and a fresh casting is normally loaded at the position on the left in the foreground in Fig. 18. A casting which has made a complete circuit of the table is transferred to the right-hand position, where the locating dowel pin is in a slightly different position to provide for the difference in angle between the two sets of recesses. When the table is indexed, at the beginning of the automatic machining cycle, which is controlled by push-button, it carries the castings to the left through 60 deg.

This movement brings the fresh casting into position beneath a short end mill for machining a single pinion recess, and the second-circuit casting beneath a longer end mill for the double-pinion recess. In addition to machining the lower face of the



**Fig. 18.** Further details of the arrangement of the fixtures on the Archdale milling machine are here shown. Each end milling cutter is of 1 5/8 in. diameter, and serves to mill one of the recesses at each machine cycle



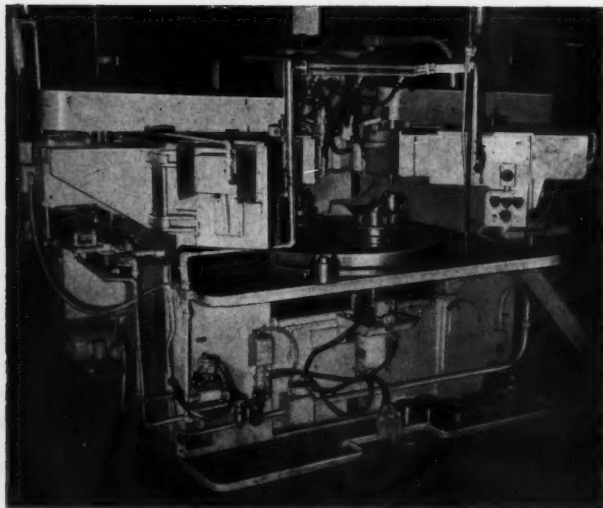


Fig. 19. The thrust surfaces at the bottoms of the recesses milled on the Archdale machine are faced during an automatic cycle on this Hoern & Dilts machine, which also faces the tops of the lugs

recess almost to the required depth, each end mill removes material from the side faces of the cast recesses. At the next indexing movement, each pair of castings is brought to an idle station, and subsequently to the next machining position, by which time they have been turned through 120 deg. by the rotation of the table. Two more recesses are then machined, and the sequence is repeated at the next two indexing motions of the table, after which the castings are returned to the loading and transfer positions at the front.

#### HOERN & DILTS VERTICAL FINE-FACING MACHINE

The next operations performed on the pinion carrier provide for fine facing the bottoms of the pinion recesses, and the top faces of the lugs, and are carried out on the Hoern & Dilts (Vaughan Associates, Ltd.) special-purpose machine indicated at B in Fig. 6. A general view of this machine, from the loading position, is given in Fig. 19, and it has an automatic indexing table of approximately 4 ft. diameter. This table is indexed through 90 deg., by a worm and wheel drive mechanism, when an air-operated, multi-plate clutch is actuated at the start of the cycle. Angular location of the table is determined by means of a massive tapered wedge, held on a pivoted arm, which is engaged with one of four slots of similar outline in the edge of the lower portion.

Near the periphery, the table carries four Eriksen, type 7B, diaphragm chucks, each with four jaws provided with hardened inserts whereby

the casting is gripped on the finished drum diameter. The diaphragm is connected to a drawbar which passes down through the table and terminates in a flange. When the table is indexed, the flange is moved into engagement with overhanging portions on a bracket attached to the ram of a vertical air cylinder which is secured to the front of the machine base. Operation of this cylinder, by means of a pedal valve at floor level, pulls down the drawbar and opens the chuck for loading or unloading. Location of the casting angularly is determined by a dowel, which is engaged with one of the rivet holes during loading.

On three sides of the table there are special

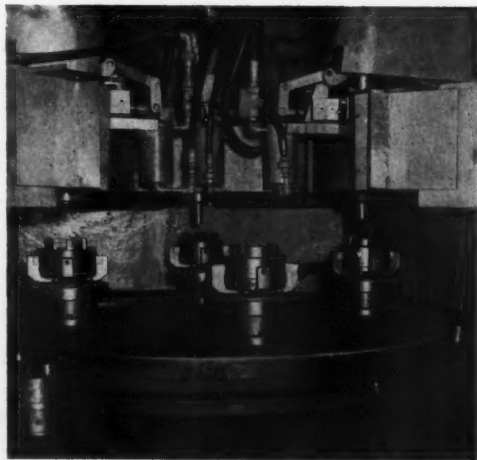
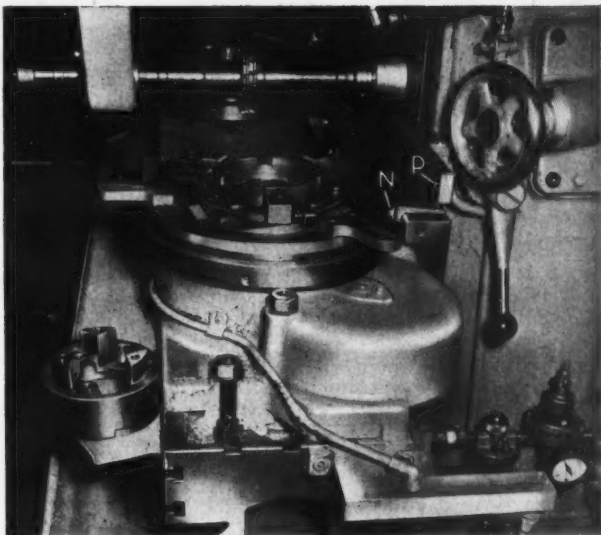


Fig. 20. Each casting on the Hoern & Dilts machine is held in a stationary diaphragm chuck in which it is carried from one spindle to the next when the table is indexed. The heads are moved in three directions in succession, at 120 deg., by a system of cams and push-rods

**Fig. 21.** A close-up view of one of the pair of similar fixtures on the Cincinnati plain horizontal milling machine employed for producing three slots in the edge of the rear drum on a completely automatic cycle



heads with vertical spindles, and each spindle is fitted with a short holder for a single-point facing tool, and is driven at a speed of 1,740 r.p.m. through V-belts by a 2 h.p. motor. Each spindle is arranged to move vertically, to bring the tool into position and withdraw it from the work, the movements being powered by a small vertical air cylinder at the front of the spindle housing. Details of the arrangements are seen in the close-up view, Fig. 20. The ram of each cylinder projects upwards, and is connected to the end of a centre-pivoted, forked lever. A groove in the upper end of the spindle quill is engaged by the forked end of the lever, and when the cylinder is actuated, the spindle is lowered or raised to a height determined by stops. Each spindle housing is connected to and supported by two horizontal slides, arranged to move in directions at 90 deg. Pressure maintained in air cylinders holds the slides in contact with the push-rods, and these push-rods are connected by levers and linkages to two cams, one for each slide. The cams for each head are driven by a common electric motor, and the drive is taken through another air-operated clutch, which is actuated after the indexing movement and engagement of the locating wedge for the table have been completed.

As the camshafts turn, movement is imparted to each of the slides carrying a spindle housing, which initially occupied a position with the spindle axis aligned with that of the chuck. The combined motions of the slides connected to the spindle housings cause the spindles of the right-hand and rear heads to be moved into the previously-milled pinion recesses, the right-hand spindle being arranged to face the deep, double-pinion recesses, and the rear spindle, the single-pinion recesses. Light cuts are thus taken across the flat bottom faces of the recesses to give the specified surface finish which must not exceed 120 micro-inches.

The cutter in the spindle of the left-hand head is set to operate on the top faces of the lugs, which

are required to be machined to the same standard of finish. After the spindles have been fed to the limit of their movements in one direction, they are returned by the cams to the central position, these movements being completed during the first one-third of the camshaft revolution. The cams are so designed that the spindles are next fed in directions at 120 deg. to those followed during the first movements, to machine adjacent recesses or faces, and subsequently returned to the centre. Finally, the spindles are again traversed in directions at 120 deg. to the two previous movements, to complete the facing operations on the recesses and the lugs.

With the spindles running continuously, the front chuck on the table is loaded as described, and the automatic cycle is started by a push-button on the panel at the right in Fig. 19. The table then indexes, carrying the freshly-loaded part to the right, where the recesses surrounding the holes Z, Fig. 12, are machined in succession, the head being fed at approximately 6 in. per min. After the next indexing movement of the table, the recesses Y, Fig. 12, are machined by the rear head, and the casting is then brought beneath the left-hand head which faces the tops of the lugs, and is finally returned to the front for unloading.

#### **MILLING PROFILED SLOTS**

Castings unloaded from the fine-facing machine are transferred to a Cincinnati type 1/24 horizontal milling machine, at F in Fig. 6, which is fitted

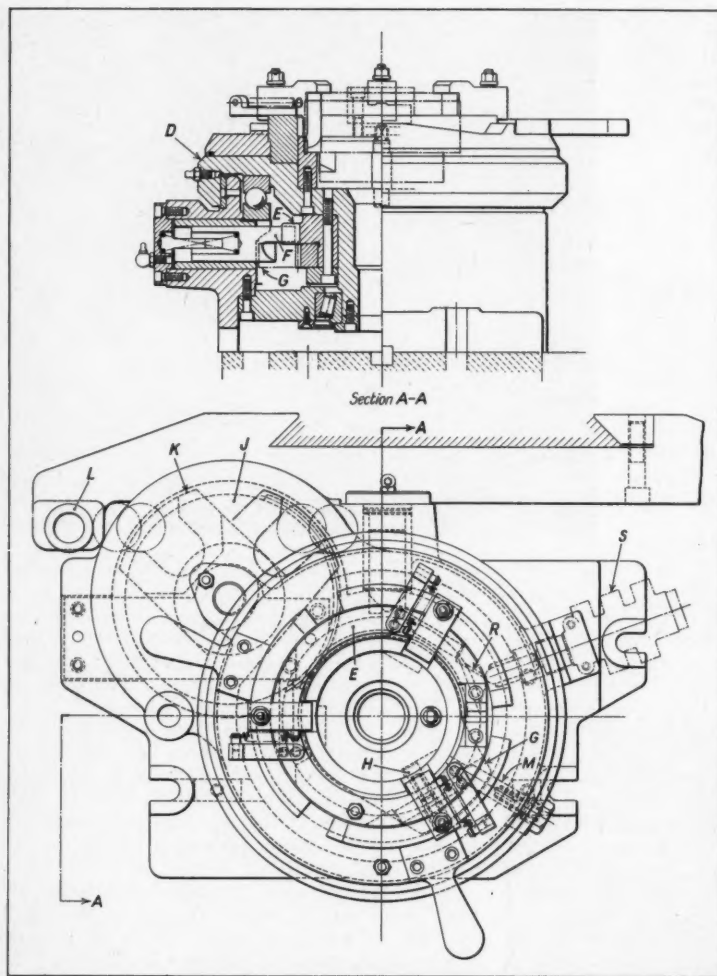


Fig. 22. Plan and part-sectional elevation of the left-hand fixture on the Cincinnati machine in Fig. 21, showing the mechanisms for locating and indexing the table between successive milling operations

Clamping force is applied to the casting by three equally-spaced, centre-pivoted levers, the outer ends of which project above cam surfaces on a ring. Each lever has a stepped bore in which a stack of Belleville washers is retained by an inverted, mushroom-headed stud. When the cam ring is turned by means of the handles provided, thrust is applied through the stud, and the Belleville washers in each lever to lift the outer end with the result that the inner end is applied to the casting rim. The levers are located between the positions at which the slots are to be machined, and the force applied is controlled by the washers.

with a long-stroke table to suit the pendulum-milling method employed. This machine provides for milling the three slots, or driving pockets, in the edge of the plain end, shown in the left-hand view in Fig. 12, at 120 deg. apart, and is equipped with two fixtures of similar design but opposite hand. The fixtures were built by the Butro Jig & Engineering Co., Ltd., to Cincinnati design, and one of them is seen in the close-up view in Fig. 21. It has a nest with a bore to fit the drum diameter, into which the casting is loaded with the lugs downwards, angular location being derived from a dowel which engages one of the pinion shaft holes.

A drawing showing one of the fixtures in plan and part-sectional elevation is given in Fig. 22, where the component is indicated by the heavy chain dotted lines. The upper portion of the fixture which forms the nest is attached to a circular table *D*, which is supported on a large ball thrust race. A reduced diameter portion of the table carries an indexing plate *E*, with three slots at 120 deg. apart, one edge of each slot being radial, as shown in the plan view. At the side of the fixture nearer the machine column, there is a horizontal, spring-loaded, locating plunger *F*, with an upper portion shaped to match the slots in the indexing plate. The lower portion of the plunger is formed with a rounded nose which can

be engaged, for retraction, by a cam *G*, mounted on a reduced diameter portion of the indexing plate. The operating portion of this cam is shown, in outline, displaced in the sectional view, and in the disengaged position, which it occupies during the milling operation, in the plan view.

Integral with the cam *G* there is a quadrant gear, the teeth of which extend for about 160 deg. round the circumference, and the cam is free to turn on the indexing plate. A radial bore in the cam *G* accommodates a ratchet plunger *H*, which is spring-loaded inwards, and engages one of three ratchet teeth in the lower portion of the indexing plate *E*. Thus, the cam *G* can be turned freely in the anti-clockwise direction, but when it is turned clockwise it also turns the indexing plate. The gear teeth of the cam *G* are engaged by teeth on the edge of the driving plate *J*, which is carried on ball bearings on a vertical shaft in a circular cast housing at one side of the fixture. On the under-side of the driving plate there is a forked projection *K*, which is engaged by a roller *L*, fixed to a bracket on the machine column, as the table is traversed.

During the machining of a slot, the fixture mechanism is in the position shown in the plan view, and at the end of the cutting traverse the direction of motion of the table is reversed by the action of a dog on the front edge. The fixture then travels away from the cutters, and the forked projection *K* engages with the roller to turn the driving plate clockwise. This movement is transmitted through the gear teeth to turn the cam *G* anti-clockwise to a position in which the locating plunger *F* is retracted from the index plate slot. Rotation of the index plate due to friction, after the plunger has been retracted, is prevented by the specially-shaped end of the spring-loaded detent *M*.

After reaching the limit of its travel away from the cutters, the movement of the table is again reversed and the fixture is fed forward for cutting the second slot. During the first part of the table travel, the fork of the projection *K*, which is now in the position shown by the dotted outline, once more engages the roller and the driving plate is turned anti-clockwise. As a result, the cam *G* is turned clockwise, the indexing plate being carried with it owing to the action of the ratchet plunger *H*. Due to the shape of the end of the detent plunger *M*, the edge of the locating slot can now override it, pushing the plunger into its housing, and the fixture nest is turned through 120 deg.

During the first part of the movement, the cam *G* is retracted from the main locating plunger *F*, which is allowed to move forward until the end is in contact with the periphery of the indexing plate. When the plate has been turned through 120 deg.,

the locating plunger is automatically advanced by its spring to engage the next locating slot and lock the fixture nest in position for the milling operation, which follows almost immediately.

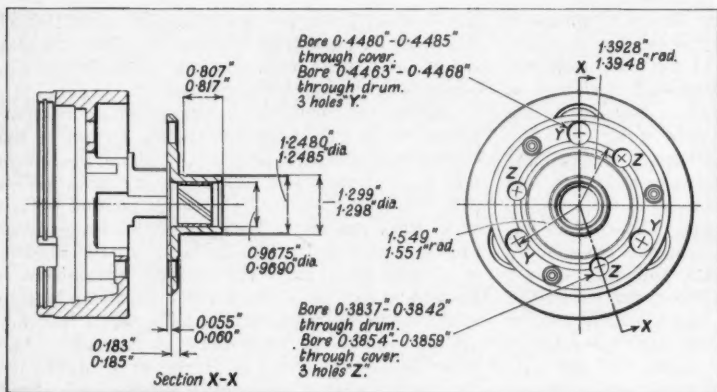
During the loading operation, which is completed while the component in the fixture at the other end of the table is being machined, the fixture nest is prevented from rotating in one direction by the detent pin *M*. To prevent rotation in the other direction, under these conditions, an auxiliary detent is provided. This detent takes the form of a spring-loaded pawl *N*, Fig. 21, pivoted in a bracket on the side of the fixture, which can engage a groove in the edge of the table when the slot-milling operations have been completed. The outer end of this pawl is depressed, to disengage the inner end from the groove automatically, by a cam *P*, secured to the machine column face, as the fixture travels towards the cutters for the machining of the first of the three slots in the freshly-loaded component.

Movements of the table during the machining cycle are controlled automatically by means of the normal dogs in T-slots in the front edge, which actuate the feed control lever projecting from the bed. Movements of the table between the milling operations take place at fast traverse rates, and milling is carried out with a feed of 1.5 in. per min. The cycle may follow immediately the previous sequence has been completed, or may be initiated by the operator, and the table makes the three successive movements towards and away from the cutters to produce the three slots, as described. The complete revolution of the indexing plate *E*, which is thus obtained, brings a cam projection *R*, Fig. 22, into contact with the plunger of a 4-way control valve *S*, connected to an air cylinder at the centre of the table.

The ram of this cylinder is connected by a bell-crank to a vertical slide on the front edge of the table, which carries dogs and is raised or lowered when the cylinder is operated. It is arranged that when the cylinder is operated after three slots have been completed in one of the parts, the dogs are displaced so that the control lever is not actuated as the fixture moves away from the cutters. The table thus travels on past its normal reversing point, and the series of operations on the part in the other fixture is begun without a pause. A corresponding cam in the other fixture is so positioned that it operates a valve to restore the reversing dog to the operative setting as the indexing movement takes place during the first approach to the cutters.

Made by Bravshaw Tools, Ltd., the cutters on the machine in Fig. 21 are of special paired design, with their inner faces at complementary angles to





**Fig. 23.** Drawing showing the rear drum and cover components after assembly, and some of the dimensions to which they are subsequently machined. Close limits are specified for concentricity and squareness of the various diameters and faces

ensure overlapping of successive teeth so that smooth surfaces are produced. The cutters are of 4 in. diameter, with 18 teeth, and are of special form to produce the raised portion required at the centre of each slot. It may be noted that the form of the slots has recently been modified to a plain shape, as shown in Fig. 12, so that cutters of simpler form will be used when those in stock are replaced.

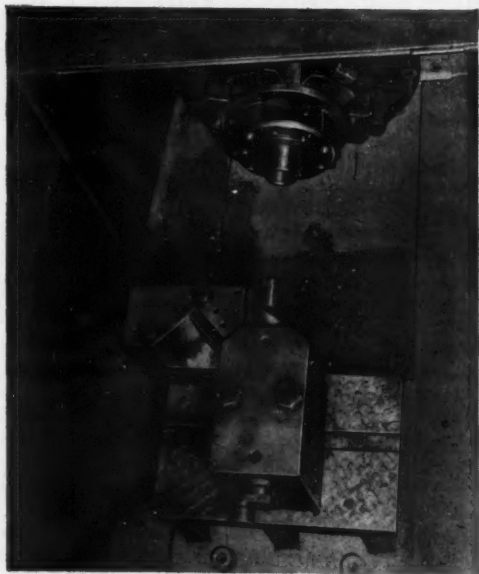
Before assembly, which is next carried out, both the cover and drum components are placed in a wire basket and washed in paraffin in the tank unit G, Fig. 6. A power-operated hoist is provided to avoid the need for lifting heavy loads. For the assembly operation, a Denison (Gaston E. Marbaix, Ltd.) Hydraulic Multipress of 35 tons capacity, at P in Fig. 6, is fitted with a simple tool in which the work is manually located on a spring-loaded plate. The hollow ends of the accurately-ground rivets are flared out by shaped punches in the top and bottom tools, and the assembly is then transferred to an adjacent Ex-Cell-O fine-boring machine, at K in Fig. 6, for operations on the hub of the cover portion.

#### OPERATIONS ON THE PINION CARRIER ASSEMBLY

The drawing in Fig. 23 gives particulars of the surfaces machined after assembly, and it may be noted that the operations are concerned with the

outside diameter and bore of the hub, also the rear face of the cover portion, and the pinion-shaft holes. At the first operation, carried out on the Ex-Cell-O machine mentioned, which is of single-spindle design, the hub of the cover portion is turned, bored, and chamfered. The assembly is held in a Woodworth diaphragm chuck, similar to those on the machine in Fig. 15, and driven at a speed of 1,000 r.p.m.

A close-up view of the set-up, in plan, is given in Fig. 24, and it will be seen that there are two tool-holders, each with two tools. The tools in the left-hand holder are arranged to turn the outside of the



**Fig. 24.** Close-up view, from above, of the table of the Ex-Cell-O fine boring machine showing the tooling employed for turning the outside of the hub, boring, and skimming the 60-deg. internal chamfer at one end



Fig. 25. The recess in the inner surface of the cover portion of the assembly is face-ground on a Heald machine fitted with an attachment whereby the end face of the wheel is dressed to a concave form

hub to a diameter of 1.262/1.265 in. for a length of 0.807/0.817 in., and to plunge cut the chamfer at the end. At the same time, the tools in the boring bar machine the bore to a diameter of 0.9675/0.9690 in., and finish-skin the deep, 60-deg., internal chamfer at the end of the bore, which serves to locate the assembly at subsequent operations.

#### GRINDING OPERATIONS

The surface of the recess surrounding the bore in the inner side of the cover portion serves as a thrust face in the final assembly, and must therefore be accurately finished. This face is ground on a Heald (Alfred Herbert, Ltd.) type 171 special machine, installed at L in Fig. 6, and shown in Fig. 25. The assembly is again gripped on the finished brake drum diameter in a Woodworth diaphragm chuck with six jaws, and is positioned axially from the outer cover face, a closely-fitting arbor engag-

ing the bore as the assembly is loaded. The grinding spindle is driven at a speed of 17,000 r.p.m., and carries a wheel of 1½ in. diameter.

The end face of this wheel is employed for the grinding operation, and it is dressed to a concave form by means of special equipment seen beyond the spindle in Fig. 25. This equipment includes an arm carrying the dressing diamond, which is pivoted on a horizontal shaft on the wheel-head slide. On the far end of the shaft there is a shorter arm carrying a roller, which is engaged between cam surfaces on a vertical abutment on the machine base. As the wheel-head is moved towards the work, the roller traverses the cams and causes the diamond to follow a curved path across the wheel face, with the result that the edge of the wheel is left proud of the centre.

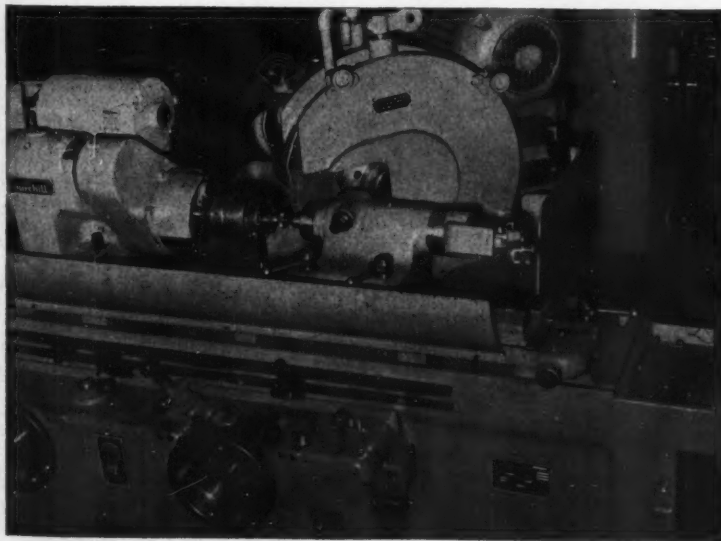
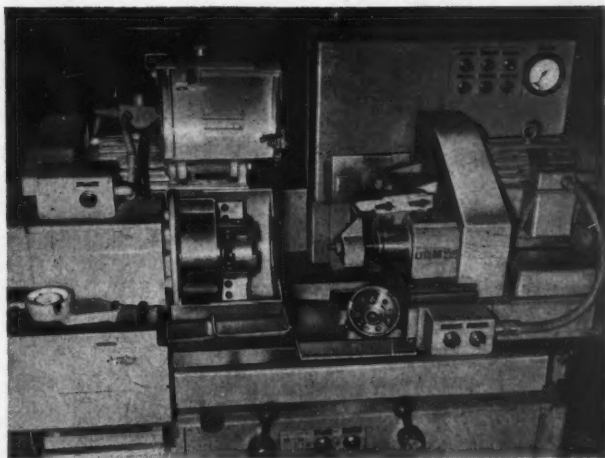
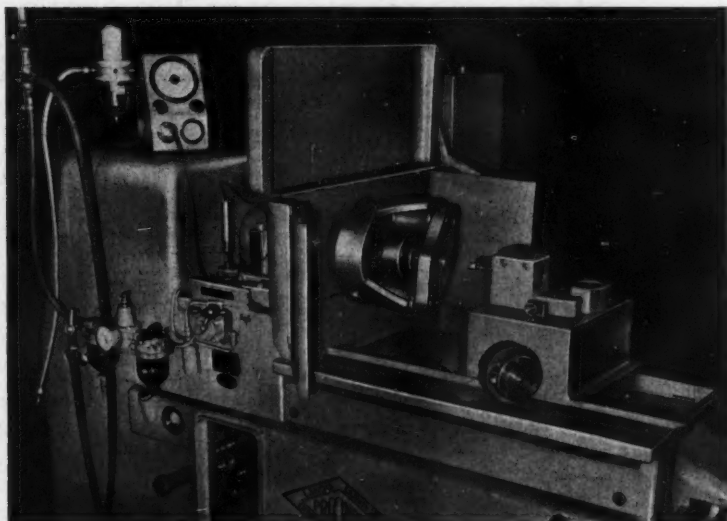


Fig. 26. For grinding the stepped diameters on the hub and the adjacent face, the assembly is mounted on an expanding arbor which is held between centres on this Churchill plain cylindrical grinding machine. The wheel head is set at an angle of 45 deg.



**Fig. 27.** This Precimax machine is employed for fine-boring the white metal-lined steel bush pressed into the bore, and is fitted with a special fixture in which the pinion carrier assembly is held by the clutch bore and the internal chamfer of the hub bore

Further movement of the wheel-slide then carries the diamond clear of the grinding wheel, and the wheel into contact with the face to be ground, under the control of the automatic feed mechanism provided. Since the wheel periphery is positioned near to the edge of the recess, the wheel is caused to follow a planetary path over the surface to be ground, every part of which is thus finished to the required standard. When the assembly is supported by the one-way clutch bore and the 60-deg. internal centre in the cover bore, the run-out of the thrust surface must not exceed 0.0005 in. per inch of diameter. During the grinding operation, a jet of coolant is directed against the work surface to remove abrasive and metallic particles which might otherwise cause scoring.

Next to the Heald machine, and tended by the same operator, there is a Churchill plain cylindrical grinding machine, indicated at N in Fig. 6, which is employed to grind the stepped outside diameter of the hub and the adjacent face of the cover. The larger diameter of the hub carries a needle thrust bearing in the finished assembly, and the adjacent area serves as a thrust face, so that both surfaces must be accurately finished. The set-up is shown in Fig. 26, and the assembly is mounted on an expanding arbor on which it is supported from the one-way clutch bore and the 60-deg. chamfer of the hub bore, the arbor being held between centres.

The wheel-head is arranged with the spindle axis at an angle of 45 deg. to that of the work, and the wheel is dressed to the required form for grinding the surfaces mentioned by means of a cam-con-

trolled unit. For grinding, the machine is operated on the normal automatic cycle employed for plain cylindrical work, the wheel-head being plunge-fed at 90 deg. to the work axis during the first part of the cycle to grind the two diameters on the hub to 1.2480/1.2485 and 1.298/1.299 in. diameter. During this stage, the operator moves the table manually to the right to bring the cover surface into contact with the other dressed face on the wheel.

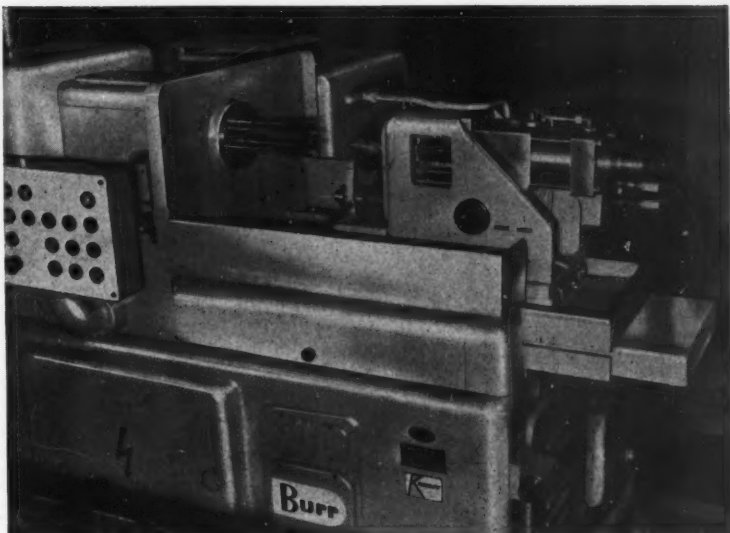
After the completion of the slow feed and spark-out periods of the automatic cycle, the table is returned to its original position to ensure that the wheel will be fed in clear of the cover face on the next component. A finish of 15 micro-inches is specified for the hub diameters, and the ground cover face must be true within 0.003 in. total indicator reading, when the assembly is mounted as previously described, and rotated.

#### **BUSH-FITTING AND BORING OPERATIONS**

A Vandervell white metal-lined steel bush is next pressed into the hub bore, as shown in Fig. 23, and a Hi-Ton (Drummond-Asquith, Ltd.), hydraulic press of 2 tons capacity, fitted with simple tooling, is used for this operation. This press is installed next to the Precimax fine-boring machine R, Fig. 6, whereby the bore of the bush is subsequently machined to 0.843/0.844 in. diameter. Fig. 27 shows the arrangements for holding the assembly during this operation, and it may be seen that the single spindle is fitted with a massive clamping unit with a main body of cast aluminium.

At the centre of the casting there is a mandrel on which the 4½-in. diameter clutch bore is located, and three plungers are moved outwards to grip the bore by actuation of an air-operated draw-bar.

Fig. 28. Conventionally arranged, with a fixed spindle head at the left, and a fixture on the hydraulically - operated table at the right, this Burr fine-boring machine is designed to line bore all six pinion shaft holes simultaneously



Diametrically - opposed buttresses on the aluminium casting incorporate bushed bores, in which plungers carrying a substantial steel cross beam are free to slide, and these plungers are connected to the draw-bar. At the centre of the beam, on the side facing the assembly, there is an annular projection with a 60-deg. conical surface to match the internal chamfer at the end of the hub bore.

When the draw-bar is actuated, the beam is moved towards the work so that the projection, which acts as a male centre, engages the internal chamfer of the hub. As a result, the assembly is located from the clutch bore and the chamfer, and is clamped securely in position. Boring is carried

out with a spindle speed of 1,000 r.p.m., and a feed rate of 0.003 in. per rev., the bar being fitted with a single point tool. The holder for the boring bar is arranged to swing about a central pivot for adjustment of the bore diameter, setting being facilitated by the knurled-head screws provided in brackets at each side.

At the right-hand side of the pivot point there is a Mercer dial gauge, with 0.0001-in divisions, whereon movements of the tool during adjustment are shown. The diameter of the bore produced at this operation stage is checked with a Mercer single-jet, air-plug gauge which is connected to a dial-type

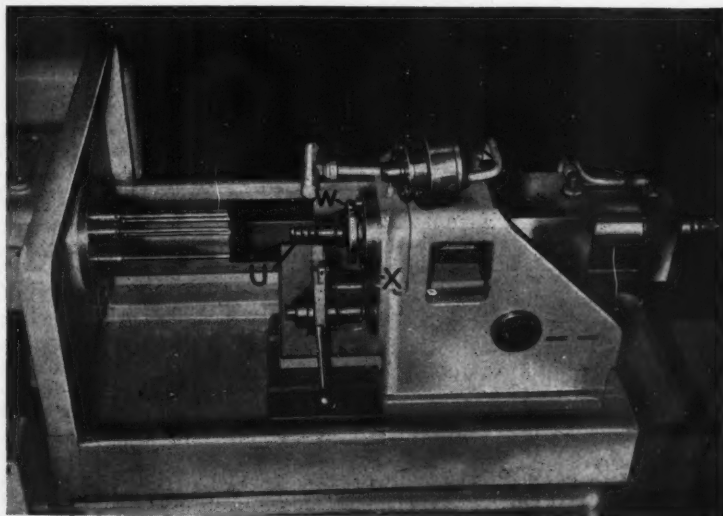
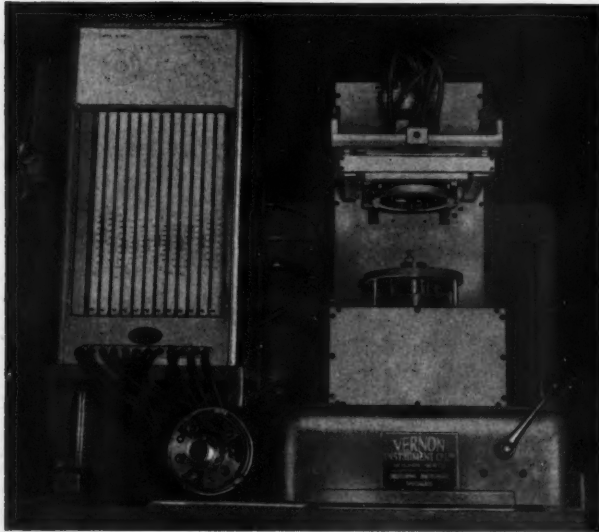


Fig. 29. In this close-up view of the Burr machine can be seen the Ringspann expanding members U and W on which the component is held, and the dowel X, on a pivoted lever, employed for accurate angular location



**Fig. 30.** The diameters of the six pairs of pinion shaft holes finished on the Burr machine are checked on this pneumatic gauging unit, supplied by Vernon Instrument Co., Ltd. Limits of 0.0005 in. are specified for the hole diameters

indicating unit seen on the spindle head cover at the left. Calibration of the instrument is performed with a master ring gauge.

#### **FINISH-BORING THE PINION SHAFT HOLES**

The pinion shaft holes indicated at Y and Z, Fig. 23, are required to be parallel with the main axis of the assembly within 0.002 in. total indicator reading over a 2 in. length, and they are bored simultaneously, to the diameter tolerances shown. This work is performed on a special Burr [George Kingsbury & Co. (Machine Tools), Ltd.] machine, S, Fig. 6, a general view of which is given in Fig. 28, where the guard has been removed to show details of the work zone. The layout of the machine is conventional, and it has a fixed spindle head at the left, with a fixture to carry the work-assembly on the hydraulically-operated table at the right.

A close-up view of the working zone of this machine is given in Fig. 29, and the method of positioning and clamping the assembly may be observed. The work is located from the clutch bore and the previously-finished bore of the bush, which are engaged with two Ringspann (Henry Pels & Co., Ltd.) hydraulically-operated expanding

elements, seen at U and W. Initial angular location is taken from one of the three slots milled on the Cincinnati machine, the slot being engaged with a dowel that projects from the face of the fixture body. A centre-pivoted lever, with a ball-handled extension, carries another dowel X, which is then engaged with one of the pinion shaft holes by rotating the lever on its pivot shaft and pushing it along the shaft towards the work. As the lever is moved, a bushed hole in an extension beneath the pivot shaft is engaged with a fixed guide shaft on the fixture face to provide the required angular location of the lever, and of the dowel X, which finally positions the casting.

A button on the control panel at the left in Fig. 28 is next depressed to operate a solenoid valve that controls the oil flow to the cylinder for operating the Ringspann elements of the fixture. This button is ineffective until a micro-switch is closed by the movement of the lever carrying the dowel X into the locating position. This lever is subsequently withdrawn to the left, and the ball-end is moved downwards about the pivot shaft to carry the lever clear of the holes for the boring operation.

The six spindles in the head at the left in Fig. 28 are driven at a speed of 3,000 r.p.m., through gearing from a 2 h.p. motor. Each spindle runs in phosphor bronze plain bearings, and the outer ends of the boring bars are piloted in bushes of similar material mounted in the fixture. To prevent inaccuracies being introduced due to expansion effects, the head is maintained at a temperature between 86 and 122 deg. F., by mains water, which is circulated by a separate pump unit at the rear of the machine, as seen in the plan view in Fig. 6. Each boring bar has two single-point tools, the second of which is set to project about 0.0008 in. further than the first, and the second tool bores the hole in the cover portion, which is completed before boring of the hole in the drum is commenced.

During the machining cycle, the table movements are completely automatic, and the component is advanced at a fast traverse rate until the holes in the cover are just clear of the first tools in the bars, followed by traverse at a slower rate until the cover has passed clear of these tools. The table is subsequently fast-traversed to bring the work into the position for the boring operation, which is performed at a feed rate of 0.0015 in. per rev., and



at the end of the cycle the spindles are stopped before the table is withdrawn at the fast rate.

### INSPECTION AND BALANCING OPERATIONS

Inspection of the diameters of the six pairs of holes after finish boring is performed on an air-operated equipment seen at the right in the background of Fig. 29. This equipment is seen more clearly in Fig. 30, and was supplied by the Vernon Instrument Co., Ltd. For checking, the work-assembly is positioned with the clutch bore downwards, and the bore is engaged with a mandrel. Angular location is by a fixed measuring plunger which enters one of the pinion shaft bores in the lower, drum portion, as the assembly is loaded. In the working position, the remaining five pinion shaft holes in the drum portion are engaged by floating plungers, and each plunger incorporates measuring air jets, which are connected to manometer tubes in the indicating instrument at the left.

At the rear of the inspection equipment is a vertical, pneumatically-operated slide, whereon an upper measuring head is flexibly mounted, also with six floating plungers and associated measuring air jets. At the centre of the ring of plungers is a tapered cone, which engages the internal chamfer

of the hub bore to position the head correctly relative to that end of the assembly, when the head is lowered by means of the air cylinder, to enter the plungers into the bores to be checked in the cover. The diameters of the bores in the cover are also shown on the manometer tubes of the indicating instrument, diagrams being provided to enable the inspector to identify any bore outside the limits.

Another inspection unit supplied by the Vernon company provides for checking the parallelism of the bores mentioned earlier, on a percentage basis. In this unit the assembly is supported by means of the clutch bore and the internal chamfer, and special Vernon type "D" mandrels are advanced into the pinion shaft bores. These mandrels automatically compensate for diameter variations, and provide a true reading of the wall position in a single vertical plane. After the check in this plane has been completed, the mandrels are turned through 90 deg. and the check is repeated, the difference in the two readings indicating the deviation from parallelism in two planes.

The final operation carried out on the last machine in the line in Fig. 6, is dynamic balancing of the assembly. Supplied by Jackson & Bradwell, Ltd., the balancing machine is shown in Fig. 31, and it incorporates a Fobco (F. O'Brian & Co., Ltd.) bench drilling machine, fitted with a  $\frac{1}{8}$  in. diameter drill. This unit is arranged to drill lightening holes in an area near the edge of the rear face of the drum portion, to a maximum depth of  $\frac{1}{32}$  in. The balancing machine has a vertical spindle driven by a motor below and the spindle is fitted with a circular table, the periphery of which is calibrated to correspond to the numbers on one of the dials at the left. When the table is rotated, the needle on this dial indicates the angular position of the unbalance in the assembly—that is the position from which metal must be removed.

The second dial, graduated in in.-oz. divisions, provides an indication of the amount of metal that must be removed to produce a balanced condition. Correction is performed manually, by drilling a hole of suitable depth at the angular position indicated. A maximum unbalance of 0.25 in.-oz. is specified, and after balancing has been completed, the assembly is packed into a box pallet for transfer to the stores or assembly areas.

Further articles in this series, to be published later in **MACHINERY**, will be concerned with the production of other transmission components.



**Fig. 31.** The final operation on the pinion carrier line is the dynamic balancing of the assemblies, which is performed on this Jackson & Bradwell, semi-automatic machine. The position and amount of unbalance are indicated on the dials at the left

**EARTH-MOVING MACHINERY** built in this country during the first quarter of this year had a total value of £15,987,000, and equipment to the value of £7,821,000 was exported. Corresponding figures for last year are £13,317 and £6,291,000.



## Flash-welding Aluminium to Copper

By C. DANA MOORE\*

ANY FLASH-WELDING MACHINE designed to weld aluminium to copper must compensate for characteristics in each metal which are unfavourable to the process. Of these characteristics, the three most important are: (1) the thermal conductivity, (2) the resistance to electrical current, and (3) the temperature range corresponding to the plastic state.

Unfortunately, both copper and aluminium are excellent heat conductors, copper being somewhat better in this respect than aluminium. Electrical current for resistance welding, therefore, must be intense, and synchronized with extreme accuracy. Furthermore, to enable welding to be performed correctly, the machine must incorporate a means of equating the differences in the conductivity of the two metals.

As compared with that of low-carbon steels, the electrical conductivity of the aluminium is high, and that of copper, even higher. This property is undesirable for flash welding because of the difficulty of concentrating controlled, effective heat in the weld area.

\* Thomson Electric Welder Co., U.S.A.

Between certain temperatures a metal is neither totally solid nor completely liquid. With aluminium and copper this temperature range is narrow, and the change from a solid to a liquid state occurs quite rapidly. The problem is further complicated by the fact that aluminium begins to flow before copper, as will be evident from the fact that the melting points are 1,220 and 1,981 deg. F., respectively. It is also necessary to provide for a wide variety of joints, some examples of which are shown in Fig. 1.

Recently the Thomson Electric Welder Co., Lynn, Mass., U.S.A., developed and patented the Synchromatic mechanical system for flash-butt welding machines and supplemented it with the Dual Force auxiliary upsetting control, which enables consistent results to be obtained. A machine with this equipment is shown in Fig. 2.

The aim in flash-welding non-ferrous metals is to shorten the time interval between "flash-off" (switching on the heating current) and the application of forging force to the point where the two occur virtually instantaneously, and the metals are forged and fused together at the optimum moment. The flashing-speed curve should be parabolic, with no interruption while upset-forging force is being exerted. Moreover, the forging force should preferably be applied in two increments—the first for combining the granular structures of the parts, and the second for compressing the eutectic phases, and expelling the relative weak materials at the interface. This sequence ensures maximum ductility in the weld, as will be evident from Fig. 3. The Synchromatic mechanism releases stored energy at the exact instant necessary to overcome the inertia of the platens and synchronise flash-off and forging force.

This mechanism, which is designed to meet individual requirements, incorporates a hydraulic flow-control valve; a "snubbing" cylinder; a double-acting, pneumatic push-up cylinder; and a crank and linkages connected to a movable platen. The

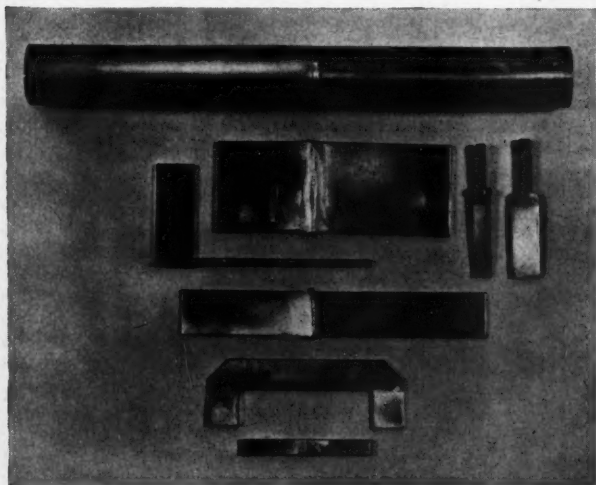
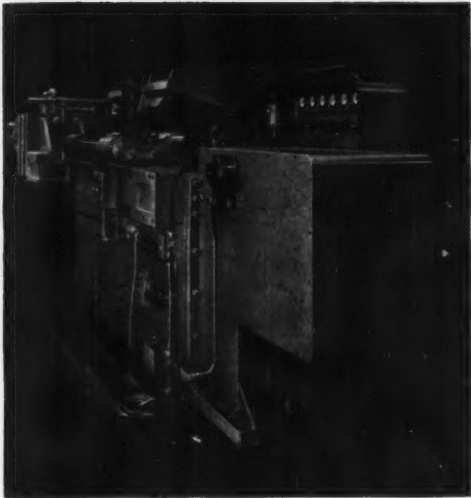


Fig. 1. Some representative examples of aluminium-to-copper flash-butt welding



**Fig. 2.** A flash-butt welding machine for joining copper to aluminium, copper to copper, or aluminium to aluminium. Sections as large as  $\frac{3}{4}$  by 6 in. can be welded. Upsetting and forging force are applied by an automatic mechanism enclosed at the right-hand end of the unit, which controls large air cylinders at the far end

mechanical cycle operates in conjunction with a secondary pneumatic system (the Dual Force) which provides the synchronization so essential to the process. As the term implies, a second forging force, transmitted from an auxiliary cylinder to the platen, follows in automatic sequence. The degree of force may be varied by means of a solenoid control, and timing is pre-set by means of dials.

Depending on the coefficient of friction of the parts to be welded, the clamping force which must be exerted to hold the work is generally between two and three times the forging force.

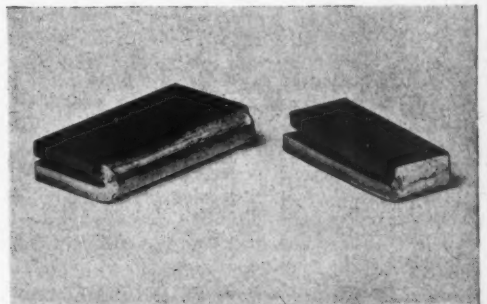
For most aluminium-to-copper applications, the ratio is 2.5 to 1 when the parts are not serrated. Sturdy air or hydraulic clamping arrangements are therefore required. Clamp design will depend on the assembly to be welded. Alligator, horizontal, and bridge type clamps are most commonly employed.

Pinch-off tools make an important contribution to the efficiency of a flash-welding machine. Developed by the author's company, these hot cutters automatically scalp material expelled from the weld area and provide additional support for the parts being welded, which helps to prevent bunch-

ing during forging. The dies are mounted on the platens and are adjustable and removable. Immediately the forging cycle has been completed, one die, actuated by the automatic mechanism, moves horizontally to seat against a mating stationary member. During this movement, it shears off the flash metal before it has cooled. This automatic pinch-off operation eliminates more than 90 per cent of the usual clean-up grinding, and ensures a high degree of joint uniformity.

Starting from a few isolated applications involving small strips of copper and aluminium, flash butt welding of these metals has progressed rapidly during the past few years. To-day, bars measuring  $1\frac{1}{4}$  in. thick by 3 in. wide are being joined as a production operation. It has also been found possible to weld tubing by this method, including sizes as small as  $\frac{1}{8}$ -in. bore diameter, by  $\frac{1}{8}$ -in. wall thickness. Specimens of both types have been subjected to 180-deg. bend tests and to reduced-section tensile tests, and the results have confirmed that high quality welding is obtainable with machines that provide a suitable synchronized cycle.

A leading manufacturer of refrigeration components employs copper and aluminium tubing in making refrigeration condensers and evaporators. The copper section of the unit facilitates subsequent assembly performed by the customer, on installation, because tin-lead sweated connections can be substituted for Heliarc welds. Tubing diameters range from  $\frac{1}{4}$  to  $\frac{1}{2}$  in. and the length of copper section is usually 4 in. or more. If sweat-soldering is carried out with a piece appreciably shorter than 4 in. there is excessive heating dangerously close to the weld. The end of each aluminium piece—whether straight or coiled—is



**Fig. 3.** A 180-degree bend test is one of the inspection methods by which joints are checked. These pieces show no evidence of cracking. In subsequent reduced-section tensile tests, the base metal failed before the welded joints



# The Fencing of Dangerous Machinery

By F. O'DONOGHUE

THE NATURE OF AN EMPLOYER'S duty to fence dangerous machinery has lately been considered during the hearing of two cases in the Queen's Bench Division. In these cases, in both of which well known engineering companies were involved, the facts were in some ways similar and the rights of the parties rested broadly upon the 1937 Factories Act, section 14(1) of which reads:

"Every dangerous part of any machinery, other than prime movers and transmission machinery, should be securely fenced unless it is in such a position or of such construction as to be safe to every person employed or working on the premises as it would be if securely fenced."

Mr. X, the plaintiff in one of the cases, was an experienced turret lathe setter-operator who in the course of his employment sustained injury when working on a lathe, as a result of which the little finger of his left hand was eventually amputated. At the time of the accident, he was turning on the lathe a number of "sealings" for petrol filler caps for tanks of aircraft. Each sealing was a small metal disc with a round central hole drilled in it and Mr. X placed it in a set of jaws which gripped it round the inside of the hole. Next he machined one side of the disc flat and turned a rim or boss round the hole. Sometimes it was necessary to remove a slight burring which was thrown up round the hole. In order to do this Mr. X used a scraper, which he carefully placed at an angle on the inner edge of the hole so as to avoid the rotating jaws. There was a clearance of only one-sixteenth of an inch between the front of each jaw and the disc.

On the occasion of the accident, what probably happened was that the point of the tool caught against a jaw inside the hole in the component, and although the hand did not come into contact with the jaws themselves inside the hole it was flung against something and the little finger was injured. Mr. Justice Streatfield found that there was no contributory negligence on Mr. X's part, and he then considered whether the defendants were guilty of a breach of their statutory duty under section 14. He said:

"The jaws were sticking out from the surface of the chuck. So long as they did stick out they were undoubtedly a dangerous part of the machine in the ordinary sense, so that when the machine was set in motion . . . at 500 r.p.m.,

with parts sticking out of the surface on the chuck, that would have been a serious danger and there would be an obligation to fence them. However, in one sense these jaws were fenced. They were fenced by the component itself because when the component was put on to the jaws which gripped it on the inside of the hole, the projecting parts of the jaw were completely buried. It was fenced and it was securely fenced so long as somebody did not put his finger in the hole."

Later in his judgment he referred to an earlier case in which Lord MacMillan had defined the employer's duty in these words: "The fence is intended to keep the worker out, not to keep the machine or its product in." Applying this to the present case, Mr. Justice Streatfield said that if the injury had been caused by the tool rather than some part of the plaintiff's body coming into contact with the dangerous part that was not enough, and under those circumstances he felt bound to hold that the dangerous part was fenced sufficiently within the meaning of section 14. The defendants therefore succeeded.

In the second case the plaintiff, Mr. Y, was an experienced band sawyer and his job was to cut aluminium and magnesium castings with a vertical band saw. This saw travelled clockwise round two pulleys of 2 ft. 6 in. diameter, and downwards through a slot in the table. The lower pulley was power-driven and protected by a metal plate, but the upper—an idler—was not fully covered. The essence of the case was that Mr. Y was working on a casting when it came into contact with the lower part of the top pulley, with the result that the pulley came away from its anchorage and injured his hand. He had presented the casting to the left of the saw, when in fact he should have presented it to the right—in which event the accident would not have happened. He sued the company for breach of their statutory duty under the provisions of section 14.

From this abbreviated statement of the facts it can be seen that the decision in Mr. X's case was highly relevant. Mr. Justice Hinchcliffe found that the top pulley was a dangerous part of machinery and was not securely fenced. He referred to words used by Lord Justice Denning in *Smithwick v. National Coal Board* (1950, 2 K.B. 335,351):



"It is not only the likely but also the unlikely accident against which the occupier must guard. He must guard against all conduct which he can reasonably foresee. The limit of his responsibility is only reached when the machinery is safe for all except the incalculable individual against whom no reasonable foresight can provide—the individual who does not merely do what is unlikely, but also what is unforeseeable."

And Mr. Justice Hinchcliffe quickly made it clear that he was going to dissent from the view held by Mr. Justice Streatfield in Mr. X's case. He said:

"What is the object of section 14? Is it merely to fence every dangerous part of machinery so as to prevent the body of the operator from coming into contact with it? This is the usual case, scores of which are heard in the courts. Or does it extend to machinery which is not dangerous in the absence of materials or workpieces being inserted into the machine? There is a conflict of judicial opinion in this class of case. . .

"In my judgment, the obligation imposed by section 14 is not limited to fencing a dangerous part of machinery so as to prevent the body of the operator from coming into contact with the dangerous part. The obligation extends to cover the case where a tool or a workpiece, handled by an operator, is liable to come into contact with an unfenced dangerous part of machinery and thereby cause the operator to suffer an injury."

In the present case, however, the plaintiff's injury was caused by a combination of his own negligence and the defendants' breach of statutory duty. He described the plaintiff as a frank and straightforward witness and he noted that he had admitted that he should have put the casting the other way round. In all the circumstances, continued the Judge, the plaintiff must bear one-third of the blame to the defendants' two-thirds, and this being so he recovered the sum of £428 15s. 9d. against £643 3s. 7d. which he would have been awarded, had he not been held to be one-third negligent.

These two cases, conflicting as they do on an important point, may well appear to factory owners and others to leave the law relating to their liability under section 14 in an unsatisfactory state. This matter can be cleared up either by a decision of a higher tribunal or by the action of Parliament. Clearly, in the meantime, it would be at least more prudent to be guided by the decision of Mr. Justice Hinchcliffe, although both decisions were arrived at after careful examination of the authorities.

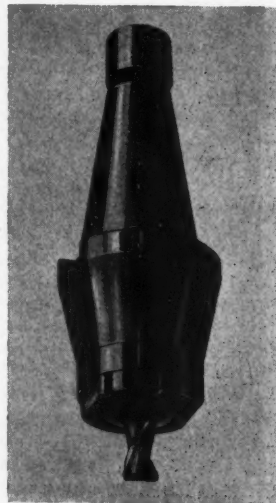
## New Clarkson S Type Autolock Chuck

The type S Autolock chuck shown in the accompanying figure has recently been introduced by Clarkson

(Engineers), Ltd., King Edward Road, Nuneaton, and is intended to take the place of the previously-made type C. Its introduction has also enabled the company to withdraw the heavy-duty range of Autolock chucks. A feature of the S-type chuck is that a combined sleeve and locknut is now employed which affords a number of advantages. For example, an increased cross-section is provided to resist the stresses that are set up at the nose end by the taper on the collet; location is taken from the face of the arbor, as well as from the bore, thereby increasing rigidity, improving accuracy, and reducing any deflection which may arise as a result of heavy cuts; and the number of separate parts in the chuck is reduced, thereby increasing the accuracy to which the unit can be produced by the manufacturer.

Drive to the collet is by way of flats, which locate in a slot, and it is claimed that this arrangement, combined with the increased section of the collet, allows heavy torque loadings to be accommodated. The cutting forces tend to tighten the sleeve and locknut against the end face of the arbor, thus increasing rigidity. Alloy steels are used for the various components of the chuck, and a closed-end drop-forged spanner is supplied.

There are two groups in the range of S-type chucks, namely the small, which accommodates  $\frac{1}{8}$ -,  $\frac{1}{4}$ -,  $\frac{3}{8}$ - and  $\frac{1}{2}$ -in. collets, for cutters up to  $\frac{1}{2}$  in. diameter; and the large, which accepts 1- and  $1\frac{1}{2}$ -in. diameter collets, for cutters ranging from  $\frac{1}{8}$  to 2 in. diameter.



An example from the recently introduced Clarkson type S range of Autolock chucks



# NEW PRODUCTION EQUIPMENT

Edited by  
G. W. Mason  
and  
A. J. Barker

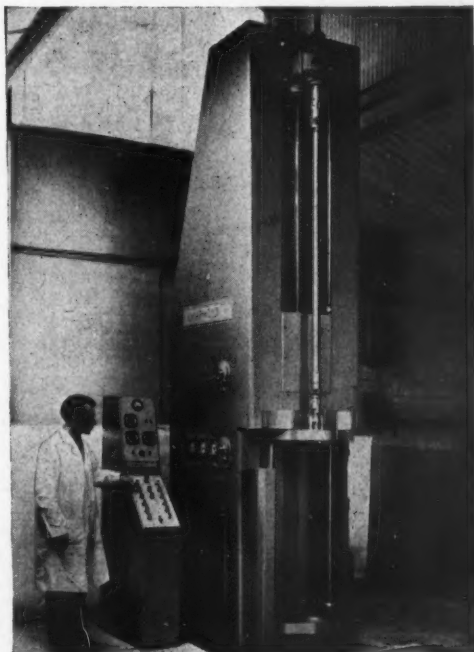
## Chaphone Vertical Honing Machines

Type C.V.3 and type C.V.5 vertical honing machines from the range made by Chaphone Engineering Developments, Ltd., Reddicap Industrial Estate, Sutton Coldfield, Warwicks., which were described in MACHINERY, 98/1465—28/6/61, can now be supplied for operation on an automatic 2-stage cycle. The type C.V.3 machine has a capacity for bores from 1 to 6 in. diameter for a maximum depth of 36 in., and the type C.V.5, which is here shown arranged for honing on a 2-stage cycle, will handle workpieces with bores from 2 to 8 in. and lengths up to 60 in.

With the new arrangement, roughing and finishing cuts can be taken on cold drawn steel tubes during a single cycle for the production of hydraulic cylinders to a high degree of accuracy for bore diameter, and with a surface finish of the order of 16 to 20 micro-inches C.L.A. The honing stones are expanded hydraulically for applying the cut, and different pressures for rough and finish honing are pre-set before the working cycle is started. When the required rate of metal removal has been determined during the honing of a sample workpiece, separate timers for controlling the rough-honing period and the overall cycle time are set. When a fresh component has been loaded on to the lower clamping table, the latter is raised hydraulically by pressing a push-button. With the completion of this movement, the workpiece is clamped at the ends between upper and lower tables, under a pressure which can be pre-set to suit the wall thickness. An interlocking arrangement is provided which prevents the honing cycle from being started until the workpiece has been clamped. The working stroke of the honing slide is automatically set to suit the component, and the minimum length that can be handled is 10 in. When the workpiece has been clamped, the honing cycle is initiated by pressing another push-button, whereupon, the honing spindle drive and the reciprocating motion are started, the coolant supply is turned on, and the stones are expanded hydraulically under the pressure pre-set for taking a roughing cut in the bore.

At the end of the rough-honing stage of the

cycle, the hydraulic pressure is automatically reduced to that which has been pre-set for taking a finishing cut on the work. At the same time a flashing-type signal lamp is illuminated, and the spindle speed is then increased and the reciprocating speed reduced by the operator. Adjustable stops are incorporated in the controls for the spindle speed and reciprocating speed to ensure that the required settings are obtained, and the stops are fitted with micro-switches, which, when they are operated, cause the signal lamp to be illuminated continuously during the finish-honing



This Chaphone type C.V.5 vertical honing machine is arranged for operation on an automatic 2-stage cycle, which provides for taking roughing and finishing cuts in the workpiece bore

stage of the cycle. At the completion of the 2-stage cycle, a spindle brake is applied, the abrasive stones are collapsed, and the spindle is brought to the top of its stroke, for unloading the workpiece.

### Pedi Tube End Profiling Machine

F. J. Edwards, Ltd., 359-361 Euston Road, London, N.W.1, are now marketing in the United Kingdom and Eire the Pedi range of machines for preparing the ends of tubes that are to be assembled at various intersecting angles to other tubes of identical or different diameters. With each of these machines, cutting is performed from inside the tube, to obviate the risk of distortion, and when preparing for a 90-deg. connection, diametrically-opposed notches are cut by means of a tool which is successively moved downwards and upwards. The cuts extend laterally to the outer surface of the tube to ensure full contact with the mating tube, and it is stated that as a result any brazing or welding operations that may be subsequently carried out are facilitated.

Round-section tube up to approximately 4½ in. diameter can be profiled, also square-section tube, and the machine can be set so that the tool is moved downwards only during each operation,

for making cuts at angles up to 30 deg. In addition, square- and triangular-shaped notches can be cut in tubes, also in channels and T-sections, and slots and circular holes can be cut close to the ends of tubes and angle. A tool can also be supplied for cutting tubes to length.

Four machines are available, and the No. 1 and 3 sizes have geared motor and flywheel drives, respectively. The No. 2 size can be supplied with geared motor, as shown in the figure, or flywheel drive. A fabricated steel pedestal is provided, and an internal chute in which cuttings are collected also serves for stiffening. Cast iron bodies are employed for the No. 1 and 2 machines, and a cast steel body for the No. 3.

Up to seven tools can be mounted, according to the size of the machine, to enable a series of operations to be performed without the need for re-setting. Individual adjustment is provided, and the tools can be quickly removed and replaced when changing over for a different component. All tools are made from high-grade steel, and can be re-ground.

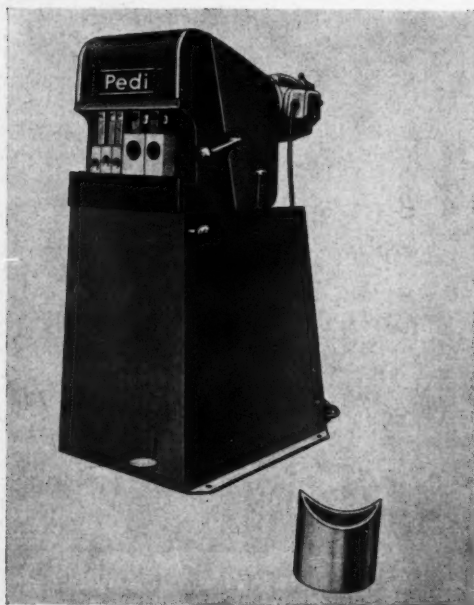
The tools are operated by means of a ram, which is guided in prismatic ways that can be adjusted, to compensate for wear. Drive is taken through an instantaneously-acting clutch, which is controlled by either a lever or a pedal.

### Noble & Lund Horizontal Millahead Machine

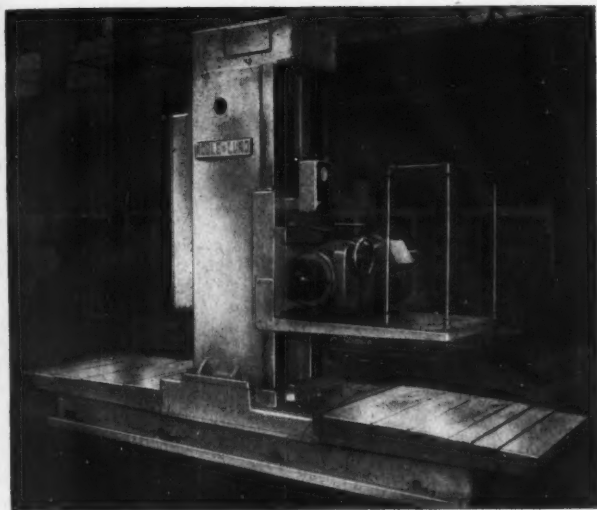
In the accompanying illustration is shown the horizontal Millahead machine which has recently been introduced by Noble & Lund, Ltd., Felling-on-Tyne. The horizontal traverse of the column on the bed is 7 ft., and the vertical traverse of the cutter head saddle on the column, 4 ft.

Main drive is provided by a 50-h.p. stator-rotor unit and the cutter spindle, which is integral with the rotor, is mounted on Timken taper roller bearings. The spindle speed is 720 r.p.m., and it is bored No. 50 International taper, and provided with a draw bar for securing cutter arbors. Axial movement of the cutter head on the saddle, over a maximum distance of 6 in., is obtained by hand, and a micrometer dial is fitted to the handwheel to permit accurate setting for depth of cut. There are twin locking levers at the top of the saddle for securing the head in the required position. The saddle is traversed on the ground flat guideways on the column by a nut and screw, drive being taken from a 3-h.p., 2-speed motor, and feed rates of 30 and 60 in. per min. are thus provided.

A platform for the operator is built on to the saddle, from which all motions of the machine



Pedi No. 2 tube end profiling machine with geared motor drive



**Noble & Lund horizontal, travelling column, Millahead milling machine, with 50-h.p. main drive**

are controlled. There is a single joy-stick lever for engaging the traverse of the column on the bed and the saddle on the column, in either direction. The spindle driving motor is started and stopped by push-buttons, and the power consumption is indicated by an ammeter.

The box section column houses a balance weight for the cutter head saddle and a compartment is provided at the rear for the electrical control gear. A 2-speed, 6 h.p. motor provides two rates of horizontal traverse, namely 30 and 60 in., per min., for the column on the ground guideways of the bed. Telescopic covers are fitted to protect the bed guideways, and there is a transparent guard round the spindle nose to shield the operator from flying chips, without obstructing his view of the cutter.

It is reported that during a recent test, the end of a universal beam of 36- by 16-in. section was milled in 2 min., with a  $\frac{1}{16}$  in. depth of cut. The weight of the machine is approximately 11½ tons.

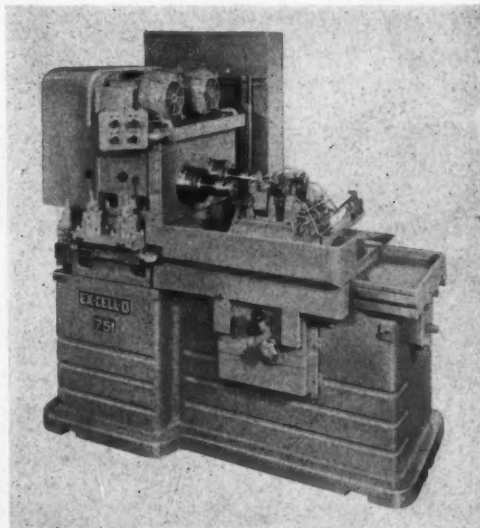
### **Ex-Cell-O Machine for Turning the Elliptical Form and Ring Lands on Pistons**

The Ex-Cell-O Corporation, Detroit, Michigan, U.S.A., have recently built the two-spindle, type 751, machine, here illustrated, for turning the skirts of aluminium pistons to an elliptical form, also for

turning the ring groove lands. Separate tool-holders are provided for these operations. On each spindle the workpiece is clamped by means of an air-operated drawbar in conjunction with a cross pin which engages the gudgeon-pin bore. Integral with each fixture there is an elliptical cam which is engaged by a follower roller on the left-hand tool-holder to produce the form on the skirt. The tool-holder is arranged to pivot, and is spring-loaded to hold the roller in contact with the cam.

The right-hand tool-holder, which turns the ring groove lands, is also pivoted, and both tool-holders are retracted from the working position hydraulically so that the machine table can be traversed rapidly back to the starting position after the completion of the automatic cycle. Cuts are taken on the two surfaces simultaneously, with the tools feeding away from the work spindles. It is stated that a mirror finish is obtained, and that the ring land diameter is held

within 0.001 in., and the elliptical form within 0.0003 in. total indicator reading. An output of 106 pieces per hour is obtained.



**Ex-Cell-O machine for turning the elliptical form and the ring lands on aluminium pistons**

The company are associated in this country with Ex-Cell-O Corporation (England), Ltd., Hastings Road, Leicester.

### Cross Drilling, Chamfering and Broaching Machine for Connecting Rods

The Cross Co., Detroit, U.S.A., have recently built the rotary indexing table machine shown in Fig. 1, for performing drilling, chamfering and broaching operations on the small-end bores of connecting rods for motor cars. The forged-steel connecting rods have a hardness of 197 to 241 Brinell, and a tolerance of  $\pm 0.0007$  in. is specified for the bore diameter.

There are six stations on the 5 ft. diameter table, at the first of which the operator loads four connecting rods into the fixture, and applies balanced hydraulic clamps, which grip the workpieces at each end. The fixtures, it may be noted, are fitted with tungsten carbide seating strips for the work. At the first machining station the holes are rough drilled to half depth, and at the next they are completed with slightly smaller drills. Station No. 4 provides for core drilling, only a small allowance being left for removal by broaching, and at the fifth station, automatic recessing tool-holders, fitted with formed bits, chamfer both sides of the drilled holes simultaneously.

In the close-up view at the sixth station, at which broaching is performed, given in Fig. 2, the workpieces may be seen in the fixture. The broaching stroke is 18 in., and front pilots are provided on the four broaches. In addition to roughing and finishing teeth on each broach, there are two

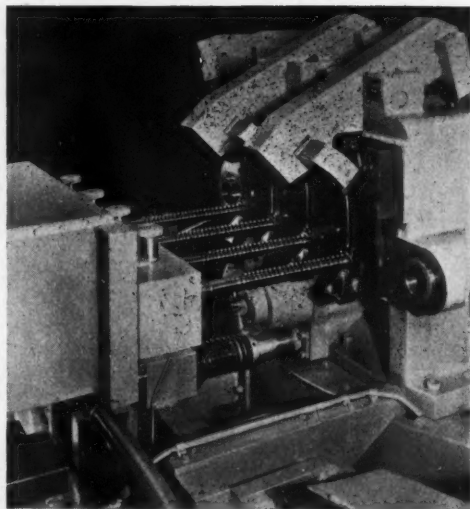


Fig. 2. Close-up view of the broaching station on the Cross machine

burnishing projections which increase the bore by 0.0003 in., and prevent drag of the cutting teeth during the withdrawal stroke, in addition to ensuring accurate size and good surface finish. A broaching speed of 30 ft. per min. is employed, and pilot portions support the broaches in the holes at the end of the stroke. A broaching force of some 4,700 lb. is applied, and to ensure a direct

line of action from the hydraulic feed cylinder to the broach head, the cylinder is mounted on top of the slide, and the piston rod is anchored in a bracket on the end of the machine base. Cam-operated clamps are automatically applied on the forward movement of the broach slide, to hold the indexing work-table securely during cutting. As the slide returns, the table clamps are released.

At each fixture station there is a coolant flow control valve, and for broaching, coolant is directed on to the tools

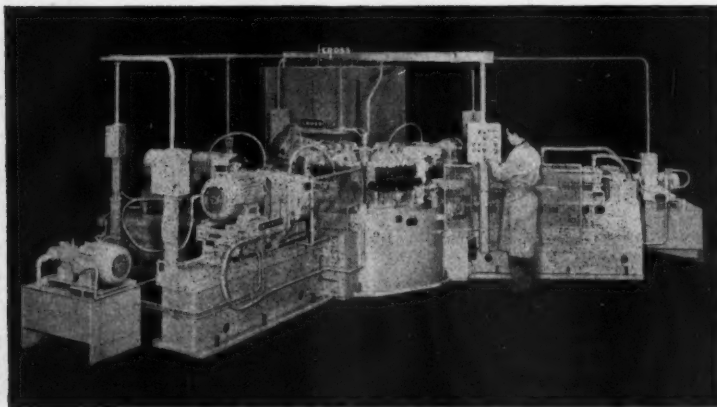


Fig. 1. Cross rotary indexing table machine for drilling, chamfering and broaching connecting rods



both as they enter and after they have passed through the holes, to ensure that chips will not be dragged back during the return stroke. The output obtainable from this machine is 500 pieces per hour at 80 per cent efficiency.

In Europe, the Cross Co. are represented by Cross International A.G., P.O. Box 300, Fribourg, Switzerland.

### Peugot 2-speed Portable Electric Drills

Melbro Machine Tools, Ltd., 2a Alexandra Road, Manchester 16, have recently introduced a new range of Peugeot 2-speed portable electric drills with capacities from  $\frac{1}{8}$  to  $1\frac{1}{4}$  in. diameter in steel.



Peugot type PF 322 2-speed,  $1\frac{1}{4}$ -in. capacity, electric drill

The largest, designated type PF 322, is shown in the accompanying illustration. The gearbox provides speeds of 156 and 280 r.p.m., under load, and the tool weighs 22 lb. These drills incorporate universal a.c./d.c. motors and are double insulated and fitted with radio suppressors.

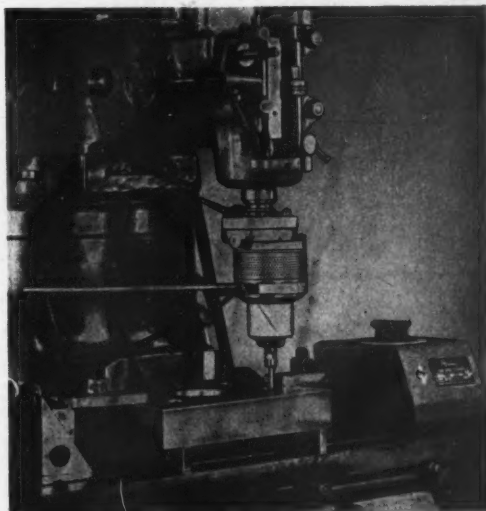
### "Precise" Electric Jig Grinders

Precise Products Corporation, Racine, Wisconsin, U.S.A., have introduced the J series electric jig grinders for use on jig borers and vertical milling machines, and one of these grinders is seen set up on a Bridgeport turret milling machine in the accompanying illustration. Holes from 0.040 to 3% in. diameter can be ground, it is stated, to tolerances well within 0.0001 in., and with surface finishes of less than 10 micro-inches. The grinders are designed for operation on a 240-volt supply and have an output of  $\frac{1}{2}$ -h.p. A control

unit, seen at the right on the machine table, enables steplessly-variable speeds from 15,000 to 45,000 r.p.m., to be obtained.

With the set-up here shown, a  $\frac{1}{8}$ -in. diameter hole is being ground with a  $\frac{1}{8}$ -in. diameter wheel, in a workpiece made from tool steel which has a hardness value of 61 Rockwell C. The spindle on the milling machine is run at a speed of 135 r.p.m. to give the required planetary motion, and the grinding spindle is driven at 45,000 r.p.m. A 2% in. diameter hole was ground in the same workpiece, and for this operation, the unit was fitted with a 1-in. diameter wheel. Again, the grinding spindle was run at 45,000 r.p.m. and the spindle on the milling machine was driven at 80 r.p.m.

On the type JA grinder, automatic feed can be applied, in increments of 0.0005 in. on diameter, while the spindle is in operation, by pressing a small button, the total amount of feed being registered on a dial. For finish sizing, the feed is applied manually by turning a dial graduated in 0.0001 in. divisions. The type JM grinder is of similar design but has hand feed mechanism only. The third grinding head, known as type J, is not provided with any feed adjustment and is intended for carrying out high-speed milling or grinding operations in the same manner as a conventional high-speed spindle. The overall length, excluding the arbor, of the type JA unit is  $8\frac{1}{8}$  in., of the type JM,  $7\frac{1}{8}$  in., and of the type J,  $5\frac{1}{8}$  in. A wide range of standard mounting arbors, of both



A Precise electric jig grinder set up on a Bridgeport milling machine



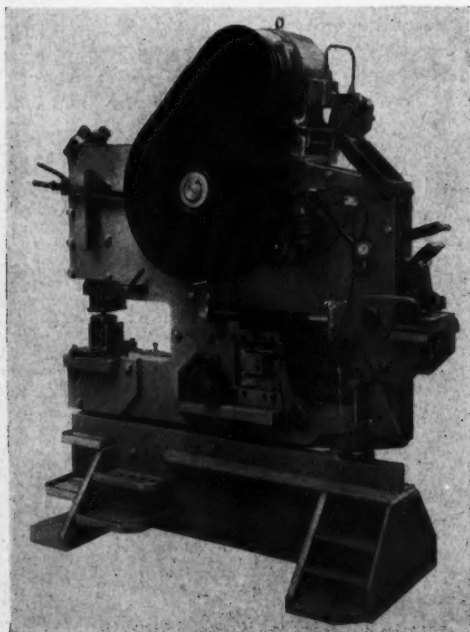
taper and parallel forms, is available, and special arbors can be supplied to suit requirements.

Equipment available for these grinders includes collets in sizes of  $\frac{3}{16}$ ,  $\frac{1}{4}$ ,  $\frac{5}{16}$ , and  $\frac{3}{8}$  in., and 3 mm. and 6 mm. diameter, tungsten-carbide jig mills in nine sizes from  $\frac{1}{16}$  to  $\frac{1}{2}$  in. diameter, and a range of porcelain bond and "super" bond grinding wheels up to 1 in. diameter by  $\frac{1}{2}$  in. face width. A diamond wheel dresser on a magnetic base is available, also an adjustable bracket, with magnetic base, to hold an indicator for centring the jig grinder.

Precise jig grinders, which are patented, are handled in this country by Matbro Machine Tools, Ltd., Beddington Lane, Croydon, Surrey.

### Kingsland Universal Punching, Shearing, Cropping and Notching Machine

The Kingsland Engineering Co., Ltd., 25-37 Hackney Road, London, E.2, have introduced the universal punching, shearing, cropping, and notching machine shown in the accompanying figure. Known as the type 21, this double-ended machine has an 18-in. deep by 9-in. high throat at the



Kingsland universal punching, shearing, cropping and notching machine

punching end. A force of 60 tons is available, and holes up to 1-in. diameter can be punched in  $\frac{1}{2}$ -in. thick mild steel.

At the opposite end of the machine, two apertures are provided for angle and section cropping. The dimensions of these apertures can be made to suit requirements, and rigid supports are fitted to ensure that accurate cuts are made. As examples of capacity, it may be noted that angle of 4 by 4 by  $\frac{1}{2}$  in., channel of 6 by 3 in., and rounds and squares up to  $1\frac{1}{2}$  in., can be cropped.

The shear blades, which have four cutting edges and are 12 in. long, are adjustable for handling thin or thick sheet, or bar. Notching is performed with a detachable unit which has hand adjustment for the position of the notch, and the latter may be of vee or rectangular form. The weight of this machine is 2 tons 1 cwt., and the drive is provided by a motor of 5 h.p.

### Granor 17-in. Centre Heavy-duty Lathe

Two Granor 17-in. centre, heavy-duty lathes, of the type illustrated in Fig. 1, each with a bed length of 24 ft., have recently been built by Graham & Normanton, Ltd., Dunkirk Mills, Dunkirk Lane Halifax, for use in the Sheffield works of a company well known in the heavy engineering field.

Each lathe admits 16-ft. between the centres and has a swing capacity of 32 in. diameter over the bed shears and 21 in. over the saddle. Main drive is taken through a flexible coupling from a 40-h.p. variable speed motor which has a basic speed of 500 r.p.m., with shunt field regulation up to 1,000 r.p.m. and magnetic amplifier control down to 125 r.p.m. This drive, in conjunction with four gear changes in the headstock provides spindle speeds from 5 to 320 r.p.m., with constant horsepower over the range from 320 to 20 r.p.m., and constant torque at the lower speeds from 20 to 5 r.p.m.

Ball or roller bearings are employed for all headstock shafts and the main spindle is mounted on two pre-loaded Timken taper roller bearings at the nose end, a ball bearing at the centre, and a parallel roller bearing at the rear. The flange diameter is 16 in. and the spindle is bored  $5\frac{1}{4}$ -in. diameter, and provided with a taper plug in the nose to receive a No. 6 Morse taper centre. Lubrication of all gearing and bearings in the headstock is by built-in, motor-driven pump, which is electrically interlocked with the main drive.

Push-button controls for starting, stopping, and inching the main driving motor, also for "advancing" and "retarding" for speed changing, together with a tachometer, an ammeter, and indicator lights for the main drive and the lubrication

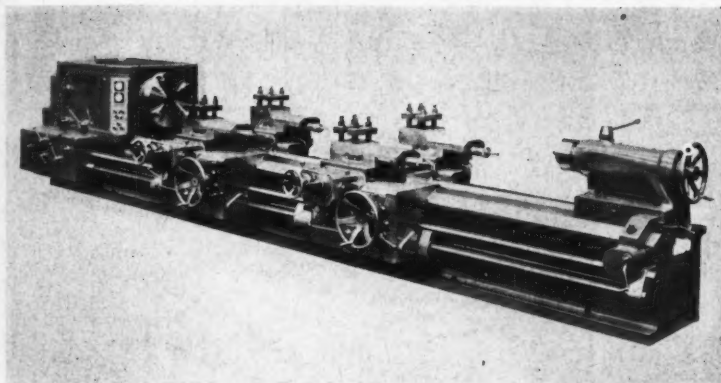


Fig. 1. Granor 17-in. centre, heavy-duty lathe, which has a 24-ft. long bed and is equipped with two saddles

pump motors, are provided on a control panel on the front of the headstock, the stopping, starting, and inching buttons being duplicated on each of the saddle units.

Feed drive is taken from the headstock through a totally enclosed gear train and the gearbox provides 16 rates from 8 to 480 cuts per in. for sliding, and from 24 to 1,440 cuts per in. for surfacing. The 3-in. diameter leadscrew is of  $\frac{1}{2}$ -in. pitch, and change gears at the end of the box enable Whitworth threads from 2 to 66 per in. to be obtained.

There are two identical saddle units, one of which is shown in the close-up view in Fig. 2. It has long bearings on the bed and can be locked in position when surfacing operations are to be performed. The apron is of the double-wall type and all high-speed shafts are mounted in ball bearings. A double-sided multi-plate friction clutch is incorporated, which provides for the engagement of feed or rapid power traverse, and the latter motion is available both for the

saddle on the bed and for the front and rear slides. The 2-h.p. rapid traverse motor is flange mounted to the end wall of the apron and there is a spring-loaded reeling drum at the end of the bed for the supply cable and control wires. There is also a lever-operated clutch in the apron for reversing the feed.

A control box at the front of the saddle is provided with levers for engaging forward or reverse feed or rapid power traverse of the front and rear slides, and in addition to the main motor controls already

mentioned, there are forward and reverse push-buttons for the rapid traverse motor. The compound slides at the front and rear are arranged to swivel for taper turning, and the top slides, which have hand feed only, are provided with 4-bolt tool rests.

The heavy tailstock can be adjusted transversely for turning tapers of small included angle. The

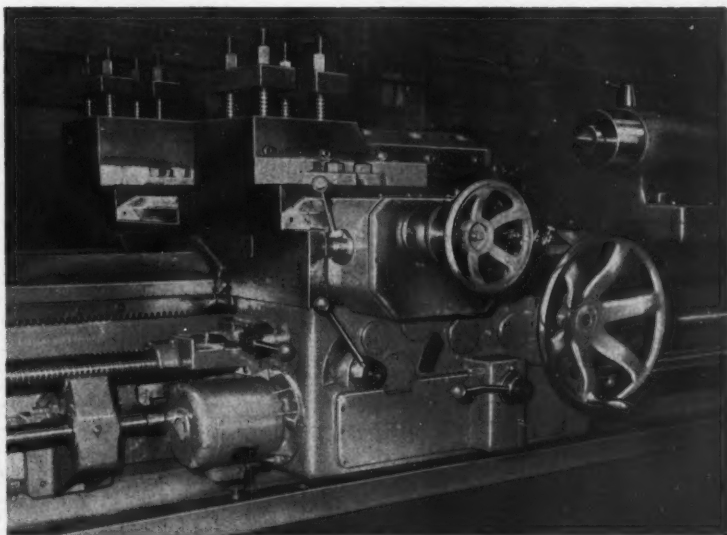


Fig. 2. A close-up view of one of the saddles on the Granor 17-in., heavy-duty lathe

barrel, of 6½ in. diameter, carries a built-in heavy-duty live centre, and can be locked in position by a pad and bolt. A large section rack is provided up the centre of the bed to take thrust loads on the tailstock.

An unsymmetrical raised V-guide is provided at the front of the bed for the saddles, and a symmetrical raised V-guide at the rear for the tailstock. The width across the shears is 33 in., and chutes are incorporated for directing cuttings and coolant to the rear of the machine.

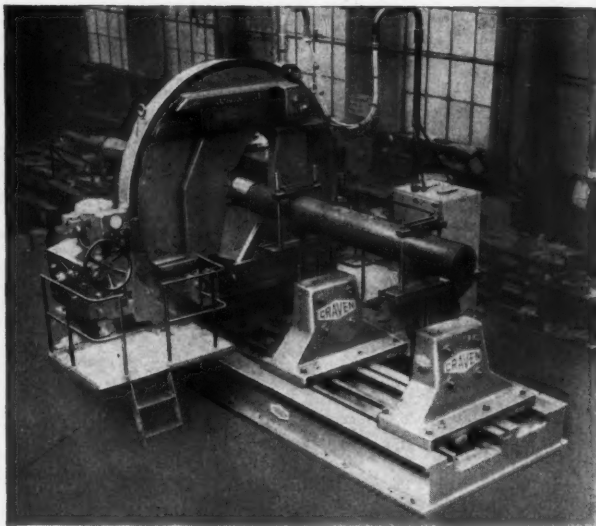
The lathe occupies a floor space of 29 ft. 3 in. by 8 ft., and weighs approximately 42 tons.

### Craven Rotary-head Crankpin Turning Machine

Crankpins from 6 to 18 in. diameter, on shafts with throws up to 18 in., can be turned on rotary-head machines built by Craven Brothers (Manchester), Ltd., Vauxhall Works, Reddish, Stockport, and in the accompanying illustration, one of these machines, destined for export to Spain, is seen set up for testing on a plain bar.

The stationary work extends through the 5-ft. diameter bore of the rotary head, on one face of which two diametrically-opposed tool slides are mounted on ways for movement radially. Speeds ranging from 2 to 20 r.p.m. are obtainable for the head, and drive is taken from a 25-h.p. variable-speed motor through a gearbox and a helical gearing. The head runs in bronze half-bearings in a housing, and by means of wedge-type segmental pads it is held firmly in the lower member, in which it is bedded, so that there is no tendency for "rolling" to occur. A small clearance is provided by the upper bearing half, to allow for expansion, and the arrangement as a whole is designed to ensure that high accuracy for roundness of the work is maintained.

Feed can be applied individually or simultaneously to the tool slides, for facing the webs and forming radii at the ends of each crankpin, and drive is taken from the gearing for the head, and is transmitted through a feed gearbox and a differential unit to a gear ring, which rotates on the head, and thence by way of spur and bevel gearing to the traversing screws. For turning the cylindrical portion of the pin, the saddle carrying the head is traversed along ways on the 24-ft. long bed, and drive for this motion is taken from



Crankpins from 6 to 18 in. diameter can be turned on this Craven rotary-head machine

the feed gearbox to a rotary nut, which engages a screw mounted between the bed-ways. Radial and longitudinal feeds from 0.007 to 0.154 in. per rev. of the head are obtainable, and rapid power traverse is provided by a separate motor. In addition, the slides and the saddle can be adjusted manually. For setting to suit the crank throw of the workpiece, the head can be adjusted manually for a distance of 18 in. across the saddle.

Mounted on the bed-ways, the three work-support pedestals which are supplied are arranged to suit the crankshaft to be machined, and are equipped with V-blocks, in which the work is located by the journal bearing portions, and clamped. Further clamps on two of the pedestals provide for gripping webs on the shaft, to prevent rotation while machining is in progress.

**SPREADER NOZZLE FOR METAL SPRAYING PISTOL.** To enable metal to be applied economically at high deposition rates, Metallization, Ltd., Pear Tree Lane, Dudley, Worcs., have introduced an auxiliary spreader nozzle, for attachment to their Mark 33 metal spraying pistol. When this nozzle is in use, it is stated, the effective width of the spray stream from ⅜-in. diameter wire is increased to 3 in. at normal spraying distance, which offers considerable advantage when large surface areas are to be coated.

## Hymatic Semi-automatic Tyre Valve Inserting Machine

The Hymatic Engineering Co., Ltd., Glover Street, Redditch, Worcs., have recently built for Standard-Triumph International, Ltd., Coventry, the semi-automatic machine shown in Fig. 1 for inserting either  $\frac{1}{8}$ -in. or  $\frac{3}{8}$ -in. size valves into motor car wheels which are subsequently fitted with tubeless tyres. Valves of the two sizes are segregated in two vibratory bowl feeders on top of the machine. After being automatically orientated, the valves are fed into separate tracks, wherein they are held by escapement mechanisms.

When a wheel is loaded on to the inclined table at the front of the machine it is rotated by hand until a spring-loaded plunger engages in the valve aperture. The depth to which the plunger enters determines which of the escapements is operated, and the appropriate valve is released and delivered to a pair of spring-loaded clamps as shown in the close-up view, Fig. 2. With the correct valve in the clamp, the foot valve of the machine is operated and a hinged arm carrying a probe is swung into position. The valve is engaged by the end of the probe, and continued downward movement opens the clamps and carries the valve between two

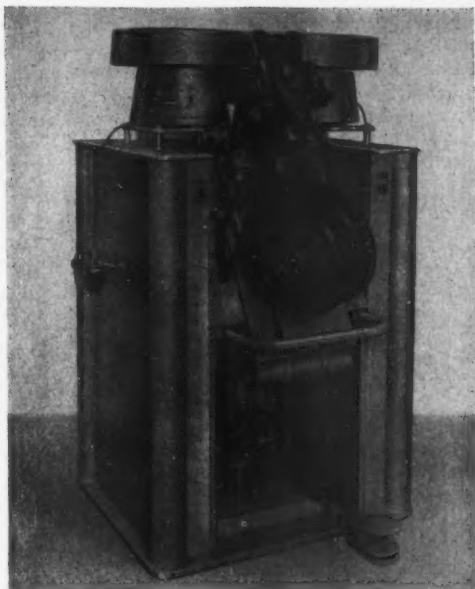


Fig. 1. General view of the Hymatic valve inserting machine showing a wheel in the loading position

soapy brushes. It may be noted that the valve is bonded into a grooved rubber sleeve which, when compressed, forms an air-tight joint with the wheel rim, and the soap provides lubrication while the rubber is being compressed into the hole in the rim by pressure exerted by the arm. During this stage of the operation, the spring-loaded location plunger is retracted by contact of the arm. When the foot

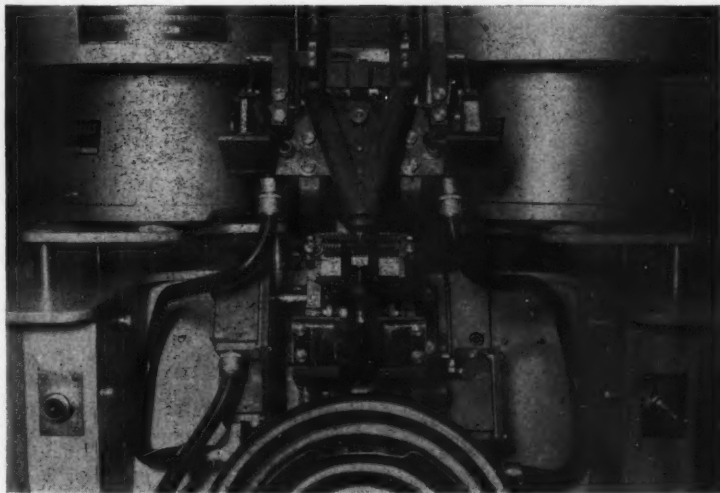


Fig. 2. Close-up view of the Hymatic machine with a valve located on the probe and just about to pass between the two soaping brushes. The spring-loaded clamp is seen in the open position



valve is released, the arm swings back and the machine is ready for the next cycle.

The soap solution for lubricating the valves is contained in a tank at the rear of the machine, the supply to the brushes being regulated by a metering valve. For purposes of illustration, the various machine guards have been removed.

## Flat Instrument Parts Finished by Double-disc Grinding

A GARDNER DOUBLE HORIZONTAL-SPINDLE disc grinder has been installed in the works of the Ford Instrument Co. division of Sperry Rand Corporation, Long Island City, N.Y., U.S.A., primarily for finishing the surfaces of aluminium plates. These plates, which are required for gear-box housings used in missile computers, are being finished by face grinding at 10 times the rate obtained with the previous method of machining.

In addition to the saving in cost that has been achieved, accuracy has been improved and there has been a considerable reduction in the number of parts rejected. The gear-box in question houses gears, shafts, potentiometers, and resolvers used in computers for the United States Navy's Tartar and Terrier missiles. The tolerances on the gear-box are such that three of the  $\frac{1}{8}$ -in. thick aluminium walls must be flat and parallel to within 0.003 in., although the plates may be as large as 14 by 18 in.

Optimum disc specifications, dressing devices,

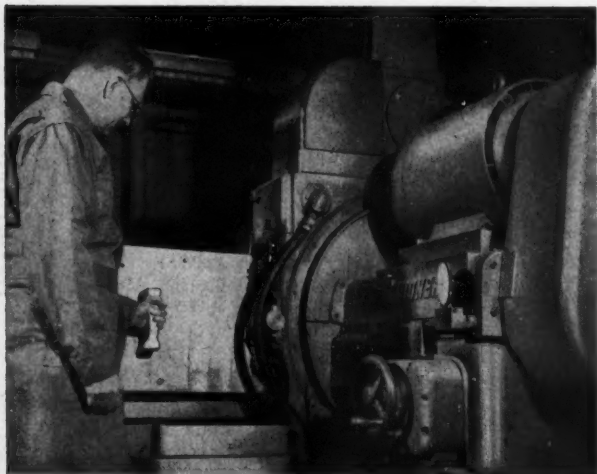


Fig. 1. Gardner double-disc machine employed for grinding the faces of flat instrument parts to within 0.0005 to 0.001 in. for flatness and parallelism



Fig. 2. Examples of hand-traversed sliding fixtures for holding parts of various shapes

coolants, and alignment settings for these operations were experimentally determined. The main problems

were to maintain constant wheel settings and to prevent excessive heating of the coolant. For a typical operation, as shown in Fig. 1, an aluminium plate is inserted by the operator in a hand-traversed fixture. This sliding fixture, which moves on precision rollers, carries the work between the opposed grinding discs. Work-holding fixtures for parts of various shapes are shown in Fig. 2.

Because the part floats freely between the discs, it can be ground on both sides simultaneously, and accuracy is thus improved, the surfaces being held within 0.0005 to 0.001 in. for flatness and parallelism. The work is loaded in the holding-fixture blade in a few seconds.

Since double-disc grinding has proved efficient for the quantity production of aluminium plates, the process is now employed by the company for similar parts where flatness and parallelism are critical. These parts include brass cam masters,





Fig. 3. Examples of flat instrument parts which have been finished on the double-disc grinder shown in Fig. 1

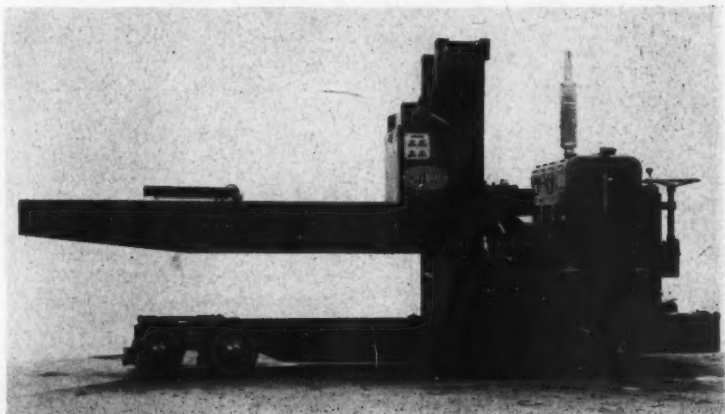
which were formerly hand scraped. Some typical components finished on the Gardner double-disc grinding machine are shown in Fig. 3.

### Greenbat 10-ton High-lift Platform Truck for Handling Press Tools

Greenwood & Batley, Ltd., Albion Works, Leeds, 12, have recently added to their range of electric vehicles a 10-ton capacity, high-lift platform truck, which is intended to facilitate the transfer of heavy press tools between the storage racks and the machines. The example shown in the figure is equipped with a platform measuring 9 ft. 10 in. by 3 ft. 8 in., and the minimum and maximum working heights obtainable are 1 ft. 6 in. and 4 ft. 6 in., but the truck can be built with modified dimensions, to suit requirements. The tool is hauled on to and pushed off the platform by means of two "bollard" motors, which are controlled by sets of push-buttons at the sides of the platform and may be operated individually

or simultaneously. Individual operation of the motors enables an angularly-positioned tool to be swung into alignment with the sides of the platform. Twin hydraulic cylinders provide for raising the platform at a speed in the region of 8 to 10 ft. per min., pressure fluid being supplied by an individual motor-driven pump. For lowering, a hydraulically-operated flow control valve is brought into use, to keep the speed within safe limits. A travelling speed of about 4 miles per hour is obtainable with full load, and drive is taken

from a heavy-duty, series-wound traction motor through single-reduction worm gearing. Steering movements are applied to all six wheels, and hydraulic equipment can be incorporated, if required, to provide power assistance. Pressure fluid is delivered to this equipment from a separate remotely controlled, motor-driven pump. Electrical current is usually supplied by a Ready Power petrol/electric unit, which is arranged to provide for automatic acceleration of any motion when the current taken from the generator exceeds 15 amp. If necessary, however, the unit can be replaced by a battery which permits normal operation.



Greenbat 10-ton high-lift platform truck for handling press tools

## Automatic Drilling Unit for Operations on Long Contoured Panels

By E. A. de VOSS\*

PRECISION MACHINING OPERATIONS on large and somewhat flexible panels often present difficulty, especially if accurate indexing of the work or machine is necessary. When the panel is cambered, twisted, or otherwise contoured, additional complications arise. If the operation is performed by a tool-head mounted on the cross-rail of a gantry, repeated adjustment of the work may be required to keep the surface normal to the tool.

This problem was encountered in its most complex form at the works of the Norair Division of Northrop Corporation, Hawthorne, Calif., U.S.A., when it became necessary to prepare large, contoured, sandwich, wing panels for laminar-flow control. It was solved in this instance by developing a small machining unit that rides on the work and automatically adjusts itself to compensate for changing contours.

A large panel section is made up by sandwiching honeycomb core between a pair of skins. Closely spaced and parallel, small plenum-chamber grooves, each  $\frac{1}{8}$  in. wide by 0.20 in. deep, and having a 0.020-in. bottom radius, must be milled for the length of the upper contoured skin sur-

\*Norair Division, Northrop Corporation, Hawthorne, Calif., U.S.A.

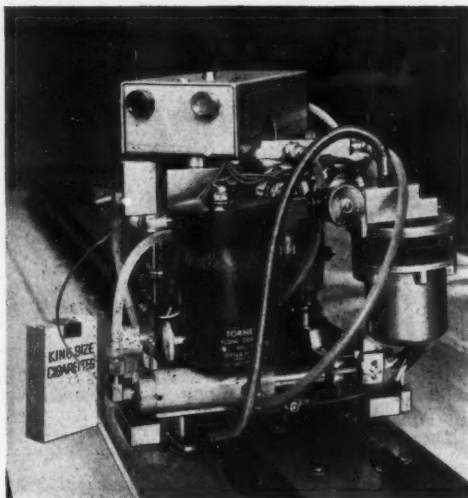
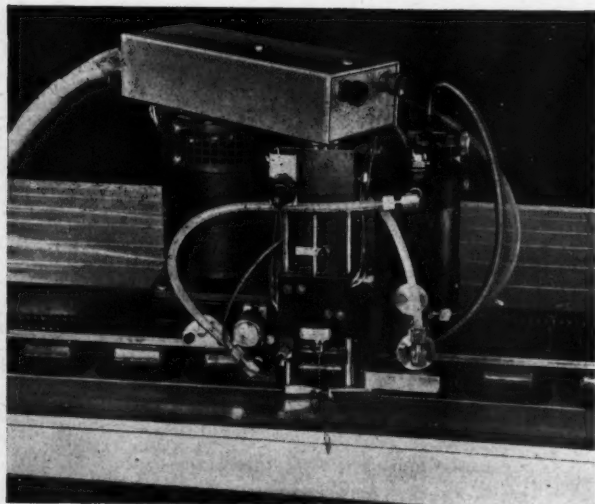


Fig. 1. This self-contained drilling unit moves along a flat track which is supported on the work and adjusts itself to curved and contoured surfaces



face. A line of holes, each of 0.052 in. diameter and spaced  $\frac{1}{4}$  in. apart, must be drilled in the bottom of each plenum-chamber groove, to pass through the honeycomb core material, and on through the lower sandwich skin.

After these operations have been carried out, a second skin is bonded to the top skin of the sandwich panel. This second skin seals off each of the milled plenum-chamber grooves. At the final machine operation, a 0.004- to 0.008-in. slit is cut with a saw

Fig. 2. A close-up view of the drilling unit showing the drill-bushing foot and tool-breakage detection circuit. Vacuum cups serve to hold the track to the work

through this external skin, directly over the centre of each plenum-chamber groove.

With this construction, laminar-flow air can pass through the slit into the plenum chamber, then down through the drilled holes to the interior of the wing. As the volume of air that follows this path must be closely controlled, the width of the slit and the diameter of the holes and their number must be accurately controlled. Consequently, close tolerances must be maintained in milling, drilling, and slitting.

As a result of research and development work, the drilling machine shown in Fig. 1 and 2 was built. This self-propelled machine is mounted on a flat, somewhat flexible steel track that conforms to the contour of the work. A machine designed on similar lines is also being built for performing the milling and slitting operations.

The track for the drilling machine is attached to the panel surface by means of rubber vacuum cups. It is a strip of cold-rolled steel  $\frac{1}{4}$  in. thick by 4 in. wide and extends for the length of the work. Metal legs moulded into each vacuum cup hold the track at a uniform distance above the work-surface. When a 28-in. vacuum is applied to the cups, they are clamped against the wing-panel surface with sufficient force to cause the track to conform to the surface contours of the panel for its full length.

Three aluminium-bronze gibs serve to guide and clamp the self-propelled drilling unit on the track. There are two stationary gibs on one side and an air-cylinder-actuated gib on the opposite side, spaced between the other two. The movable gib is arranged to tighten and loosen in synchronization with the drilling cycle as the unit moves forward in increments over the work. A ratcheting sprocket, which is also air-operated, provides for forward movements of the drilling unit in  $\frac{1}{4}$ -in. increments. This mechanism is actuated by the return cycle of the drill feed-cylinder.

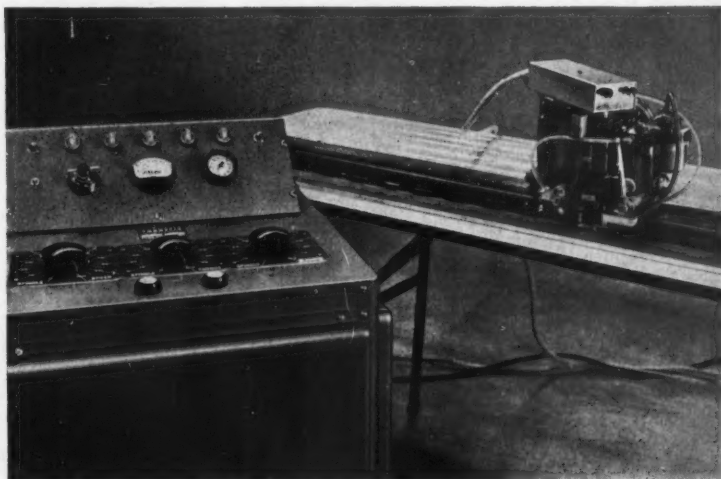
There are various areas on the wing panels where drilling is not

required. Provision has therefore been made for feeding the drilling units along such areas of the work without stopping. An electrical sliding contact is provided between the track and the drill carriage, and insulating tape is placed on the track where it extends over the area that is not to be drilled. As a result, the indexing system is initiated repeatedly until the machine has passed over the insulating tape and the sliding contact again touches the track, whereupon the drilling sequence is resumed.

The drilling unit was built to Norair specification by Dyne Systems, Inc., Torrance, Calif., and is provided with a Tornetic control system. With this control, the drilling torque is continually measured electronically and maintained at a constant level. Thus, as the drill becomes dull a feed-back signal, initiated by the cutting tool, automatically regulates the drilling speed and feed. More consistent chip removal is thus obtained, and the tool life is far greater than could be achieved with a fixed speed and feed rate.

When starting a drilling operation with a correctly sharpened drill, approximately 90 holes are produced per min. The drilling rate slows down gradually until it is evident that a drill change is required. It would continue to slow until a very dull drill would turn in contact with the work, without cutting but still without breaking. The Tornetic computer is seen in Fig. 3.

Drilling of the bottom skin of the honeycomb sandwich presented difficulties because the small-diameter drills (0.052 in.) could not be supported inside the honeycomb, and with conventional methods excessive drill breakage was experienced.



**Fig. 3.** The Tornetic computer regulates the amount of torque applied to the drill in accordance with the cutting conditions

Because of the rapidity of the drilling action, it was necessary to devise a method for stopping the feed instantly in the event of drill breakage. An automatic drill-breakage surveillance system was therefore developed.

The honeycomb bonding adhesive is so abrasive that when using conventional drilling methods approximately 48 holes per drill was the maximum that could be obtained. With the Tornetic computer system the number of holes per drill consistently exceeds 1,000, and drill breakage is kept to a minimum.

Since the drilling unit is completely automatic and provision is made for instantly stopping the unit in the event of drill breakage, the operator is relieved of the responsibility of watching the unit when it is in operation. Consequently, the only man-hours involved are for setting up the tracks and periodically changing drills.

After it has passed along the length of the track on the work the drilling unit automatically stops, is removed from the track, and transferred to another track section that has previously been set up. Then, while the unit is drilling on the new track, the first track is re-positioned. The total length of track to be negotiated to complete existing contracts amounts to approximately  $7\frac{1}{2}$  miles, and the number of holes required exceeds 1,800,000.

### Elliott Rondell Form Error Measuring Instrument

Elliott Bros. (London), Ltd., Elstree Way, Boreham Wood, Herts., have introduced an extremely accurate form error measuring instrument known as the Rondell, which is shown in the accompanying illustration, and is the subject of world-wide patent applications. In addition to checking for out-of-roundness, it will measure the eccentricity of a diameter with any other, also squareness of end faces or shoulders with respect to a reference axis. The parallelism of end faces with respect to each other, or to shoulders, can also be checked, together with squareness of an axis with respect to a reference plane, and misalignment of axes. The ultra-precision reference bearing, which defines the reference axis and the reference plane, is of novel design, and has the property of self-improvement so that its accuracy increases with use.

Specimens up to  $4\frac{1}{4}$  in. diameter by 7 in. high can be accommodated. The maximum probing depth in bores of 3 in. diameter and over, is 4 in., and with a special probe, a depth of  $\frac{1}{4}$  in. can be reached in bores down to 0.05 in. diameter. A maximum magnification of  $10,000\times$  is provided



Rondell form error measuring instrument introduced by Elliott Bros. (London), Ltd.

by the electrical measuring head and the readings can be displayed on a meter, or recorded on a polar chart to an accuracy of 3 micro-inches.

The work table is hardened and lapped flat over the whole area to an accuracy of one-half a fringe of white light. Fine centring of the table can be effected with three knurled screws, the  $\frac{1}{2}$  in. travel of which corresponds to 0.002 in. movement of the table. A spherical table mounting is employed to facilitate levelling, the centre of the mounting being located  $\frac{1}{8}$  in. above the table face so that the centring of a small specimen is virtually unaffected by the levelling adjustment. The level setting accuracy is stated to be better than 1 sec. of arc. The work table is rotated through a kinematic coupling which ensures that only a couple in the plane of the bearing is transmitted to the table, and speeds up to 10 r.p.m. can be obtained.

Contours of circular specimens are traced by an electrical measuring probe, which is mounted on a screw-operated slide on the column, and can be rotated on a vertical axis. The slide, column and probe mounting can be locked in any setting required for presentation of the probe to the specimen, and the probe arms are easily interchanged to provide for the examination of the various surfaces. For checking cylinders for parallelism, also generators of surfaces of revolution, the probe arm can be moved vertically, and it is stated that this motion is rectilinear within 10 micro-inches per in.



## Yoder Tube Mill with Type V Vapour-cooled Resistance Welder

The Yoder Co., Cleveland, Ohio, U.S.A., have recently developed a new design of vapour-cooled resistance welding unit for application to tube forming mills, for which considerable advantages are claimed. A tube mill fitted with this unit is illustrated in Fig. 1, and Fig. 2 is a sectional view, showing the construction. The entire unit is carried on a heavy steel shaft and is provided with a support plate upon which the electrodes are mounted. Working load is transmitted directly to the shaft and is not required to pass through the transformer primary or secondary.

Of toroidal form, the transformer is mounted within a one-piece copper secondary which also forms a protecting case. Primary connections pass through the support shaft, which is hollow, to

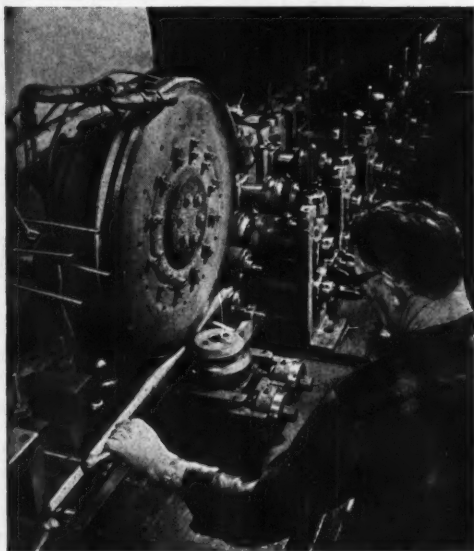


Fig. 1. Yoder tube mill equipped with the new type V vapour-cooled resistance welding unit

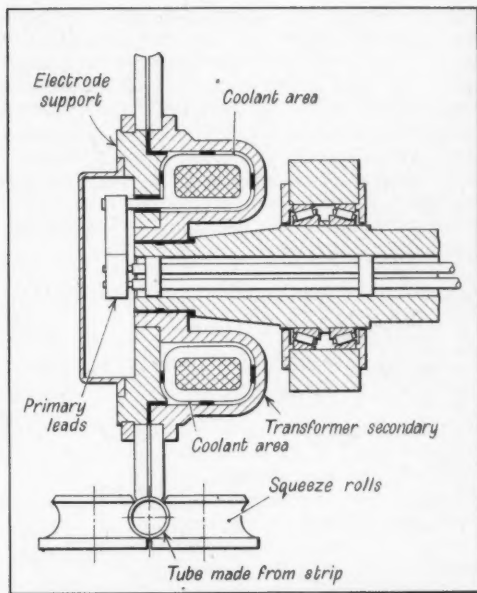


Fig. 2. Sectional drawing showing the construction of the Yoder type V welding unit

terminal studs in the front of the case, all these connections being sealed under a waterproof cover. With this design, there are no long conductors in the secondary circuit, and the transformer is sufficiently small to be mounted on the support plate, and connected directly to the electrodes.

The primary winding and core are cooled by an inert liquid dielectric, Minnesota Mining FC-75, which is sealed within the unit and transfers any heat developed to the copper secondary case. Heat from the latter is removed by the external water supply employed for cooling the electrodes. As the heat builds up inside the unit, the liquid vaporises, and then condenses again on contact with the cooled case.

Of grain-orientated silicon steel, the transformer core is ribbon wound, and the core and primary assembly is vacuum impregnated with epoxy resin. A safety device is incorporated whereby the welding current is switched off in the event of thermal overload. Because of the design features and materials employed, however, internal temperatures up to 300 deg. F. can be tolerated, while the electrode temperature is only 130 to 140 deg. F.

With this new welding unit, it is stated, tube production can be increased by as much as 60 per cent in comparison with that obtainable with con-

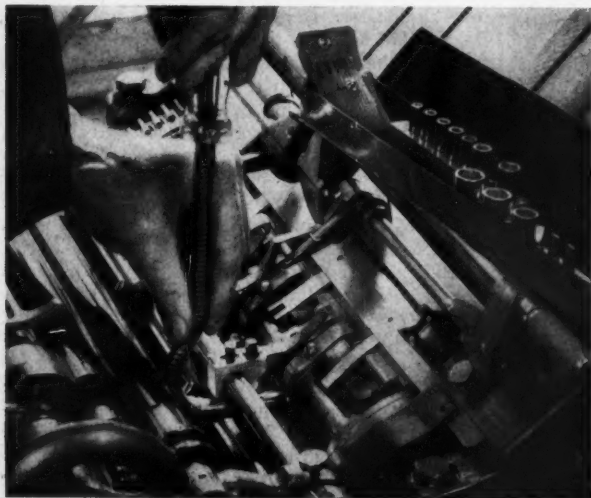


ventional equipment under identical power input and operating conditions. On the other hand, if the same speed is maintained, the power requirements are considerably reduced. As an example, 2-in. diameter tube, 0.075 in. thick, for motor car exhaust pipes is being produced from cold-rolled, aluminized steel strip at the rate of 106 ft. per min. One operator tends the continuous coil feed and another the welding unit, and they produce 3,700 pieces 101½ in. long, or 6,000 pieces 69½ in. long, per 8-hour shift.

The sole agents for the Yoder Co., in this country, are Wickman Ltd., Fletchamstead Highway, Coventry.

### Gedat Flexible Screwdriver and Nut Spanner

Scot Urquhart, Ltd., 373a Earlsfield Road, Earlsfield, London, S.W.18, are marketing in this country the Gedat flexible screwdriver and nut spanner, shown in use in the accompanying illustration. This tool, which is approximately 14 in. long, can be used in normally inaccessible positions, and it can be supplied with standard heads or special heads. Approximately one-half of the shank is flexible, and it turns within a flexible outer casing, which remains stationary while the handle is rotated. The tool is insulated and is supplied with 10 hexagon socket wrench inserts for SAE sizes from ¼ to ¾ in., screwdriver inserts, and inserts for cross-head Phillips screws. Inserts in mm. sizes can be supplied.



Gedat flexible screwdriver and nut spanner

### Dazor Floating Arm Magnifier

M. R. Aust, 51 Crawford Street, London, W.1, is the sole representative in this country for the range of floating-arm magnifiers made by the Dazor Mfg. Corp., St. Louis, Mo., U.S.A. One of these units is seen in the accompanying illustration.



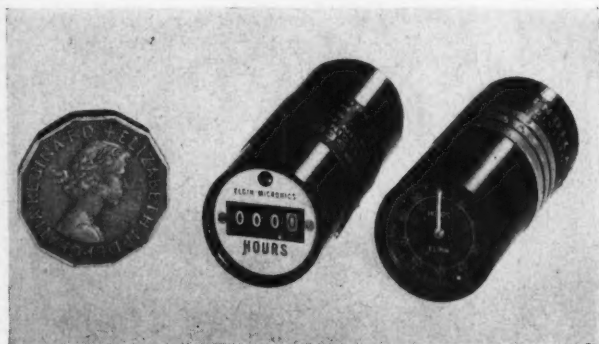
Dazor floating-arm magnifier

tion, applied to a tool grinder. It incorporates a 5-in. diameter ground and polished glass lens having a focal length of 13 in. Illumination is provided by three 6-watt fluorescent tubes which are built into the hood. The self-sustaining arm extension has a reach of 24 in. and two studs with wing nuts and clamp plates are provided in the base of the "Universal" model.

A unit for desk mounting with an 18-in. arm extension is also available, together with a pillar type unit for floor mounting, which has a 24-in. arm extension. For use where built-in lighting and the floating arm feature are not essential, there is an adjustable arm magnifier with fixing clamp, which incorporates the same 5-in. diameter lens as the unit illustrated. This magnifier can be supplied with a 20- or 31-in. extension.

## Elgin Elapsed Time Indicators

Of remarkably small dimensions, the two American-made Elgin electro-mechanical elapsed



Elgin elapsed time indicators are here shown, with a three-penny piece for comparison

time indicators which are marketed in the United Kingdom by Aeromaritime, Ltd., 45 Ladbroke Square, London, W.11, provide for recording, by means of a circular scale or numerals, the total operating time for the equipment to which they are connected. Normally, the indicators provide for operating periods up to a maximum of 1,000 hr., and measure 0.68 in. diameter. The circular scale type is 1.42 in. long and the numeral-type 1.76 in. long. The former unit can be read to an accuracy within 0.1 per cent, and both units, which weigh approximately 1½ oz. each, are seen in the accompanying figure, where a three-penny piece is also shown for comparison.

Vibration rates from 10 to 2,000 cycles per sec., with accelerating rates up to 20g, can be withstood, and the units may be employed at temperatures from -65 to +250 deg. F. Drive for the gearing of the indicating system is by a synchronous motor, suitable for use on 400-cycle, a.c. electrical supplies at 115 or 26 volts, and alternative units are available for

use on a 28-volt d.c. supply. The coils are encapsulated in an epoxy resin compound, and all shafts which run at speeds higher than 5 r.p.m. are mounted in sapphire bearings. The hermetically-sealed case is filled with an inert gas, to prevent deterioration of the mechanism due to condensation.

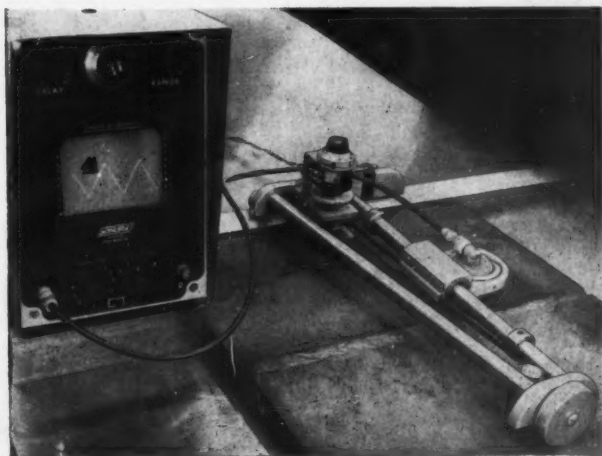
An events indicator, of similar design, is also available, and provides for counting, up to 1,000, the number of times a circuit is brought into operation, for periods as short as ½ sec.

## Branson Sonoray 5 Ultrasonic Testing Equipment

In the accompanying illustration, Sonoray 5 ultrasonic testing equipment made by Branson Instruments, Inc., 37 Brown House Road, Stamford, Conn., U.S.A., is being employed for the inspection of a welded plate. This equipment operates on what is termed the "B-scanning" principle whereby the transducer head is caused to follow a zig-zag path as it is traversed along the plate. As a result, it is stated, the location and extent of any fault such as a crack of slag inclusion, can be accurately

and rapidly determined.

In the first instance, the fault is indicated as an enlarged dot on the screen of the cathode ray tube, during the traverse motion of the transducer. If



Branson Sonoray 5 ultrasonic testing equipment which operates on the "B-scanning" principle

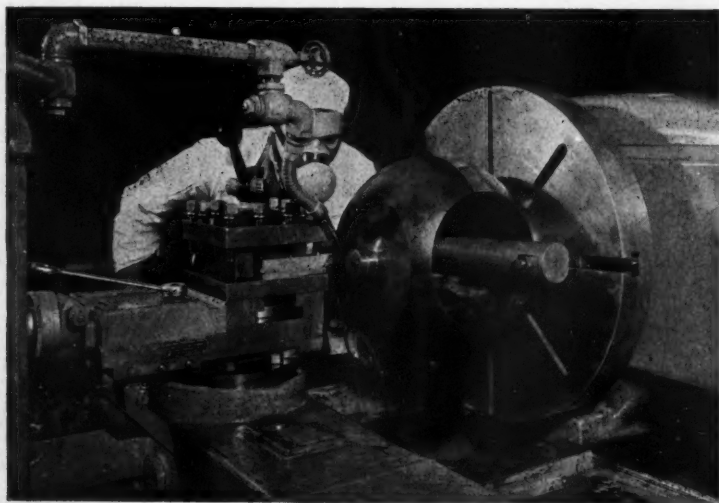
the latter is now moved to cover the suspect weld area, it will generate a series of closely-spaced dots which outline the flaw. Because the instrument screen has been treated to provide a persistent image, the dots blend into a line or area, similar to the flaw inside the weld.

Discontinuities as small as  $\frac{1}{16}$  in., it is stated, can be detected when the equipment is operated by hand, and a weld can be checked at the rate of about 1 ft. per min. To provide for faster checking, the unit can be motorized, and coupled to a recorder or flaw alarm, if desired.

Branson Instruments Inc., are associated in this country with Dawe Instruments, Ltd., 99 Uxbridge Road, London, W.5.

### Production of a Large Uranium Sphere

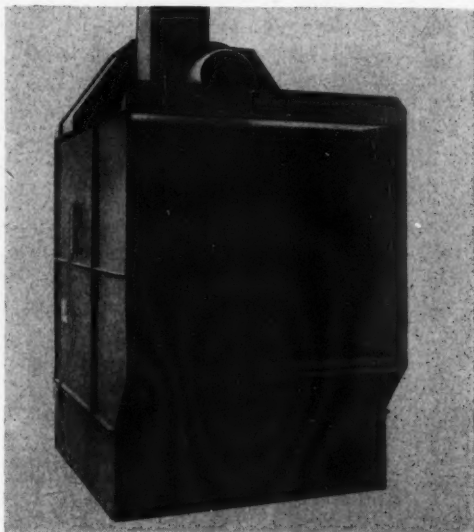
For use in a valve required in connection with the Enrico Fernie nuclear reactor, now under construction at Lagoona Beach, Michigan, U.S.A., an accurate sphere has been machined from a 500-lb. ball of uranium at the works of Hydromatics, Inc., New Jersey. The set-up for turning the sphere, which has a 10-in. bore, is seen in the accompanying illustration. It was made from spent uranium with a safe level of radiation, but special precautions were necessary on account of the inflammable nature of the chips. Machining speeds were kept low to reduce heating, and the operations occupied nearly a week, with day and night working.



Set-up for turning operations on a large uranium sphere

### Bullows Nopump Spray Booth

A new version of the Nopump spray booth, shown in the accompanying illustration, has been introduced by Alfred Bullows & Sons, Ltd., Long



Bullows Nopump self-contained spray booth

Street, Walsall, Staffs. It is a self-contained "packaged" unit which can be installed in virtually any position, and the design obviates the need for a circulating pump, filters, pipes and nozzles.

Constructed from 16 s.w.g. sheet metal, the booth measures 5 ft. wide by 4 ft. from front to rear, and has a height of 9 ft. 2 in. to the fan. It is available as a standard bench unit, which, if required, can be transformed into a full-depth unit by means of a conversion kit. A further advantage claimed for the Nopump booth is that the power

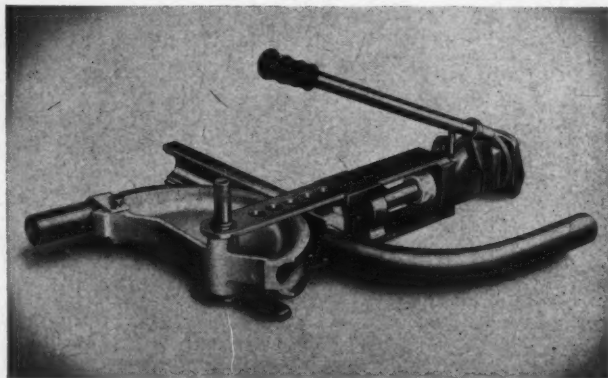
consumption is less than that of a conventional water-wash booth. The fan is driven by a 3-h.p. motor and the extraction rate is 3,500 cu. ft. of air per min.

### Staffa Rotabend C/1 Portable Tube Bending Machine

The range of Staffa tube bending machines made by Chamberlain Industries, Ltd., Staffa Works, Argall Avenue, London, E.10, a member company of the Chamberlain Group, has been extended recently by the addition of the Rotabend C/1 portable type here shown, which is primarily intended for bending unheated and unloaded copper tubes, from  $\frac{3}{4}$  to 2 in. diameter, through angles up to 180 deg.

Bending force is applied by means of a hydraulic ram, which is mounted in a self-contained, hand-operated pump unit of simple design, and is transmitted to the work by a straight-backed die of aluminium. In operation, this force serves to turn the eccentrically-pivoted, arcuate forming die, to which the work is clamped, and the bend is made progressively. With this arrangement, it is stated, the force applied to the work is automatically maintained at the required value, and the tube is bent without wrinkling.

Right- and left-hand bends can be made successively with very short intermediate straight portions, and the forming die, which is graduated to indicate the bending angle, can readily be removed and replaced, to provide for work of different sizes. Since the bending forces are balanced, the machine may be operated without the necessity for attaching it to a rigid base.



Staffa Rotabend C/1 portable type hydraulic tube bending machine

### Large Gear Hub Produced by Flame Cutting

A hub for a 25-ton gear for use in the tilting mechanism of a Bessemer steel converter was manufactured recently by the Welding Division of David Brown Industries, Ltd., at St. Andrews Road Works, Huddersfield. With the set-up shown in the illustration, a 31-in. diameter core



Set-up for flame cutting a 3-ft. thick steel forging for the hub of a large gear

was removed from a steel disc of 5 ft. diameter by 3 ft. thick on a British Oxygen flame cutting machine. In preparation for cutting, a  $1\frac{1}{2}$ -in. diameter hole was drilled through the forging, and the metal was preheated. Using B.O.C. cylinder propane and low pressure oxygen, the cutting operation was completed in 40 min.

The cut was 1-in. wide, and it is stated that the resulting bore was exceptionally smooth and that the taper over the 3-ft. depth was less than  $\frac{1}{8}$  in.

ELECTRIC CLOCKS produced in June, 1961, were valued at £102,000, an increase of almost 100 per cent on the figure for June, 1960.



## A Pneumatic Computer

Fig. 1 shows a model, made by The British Hydromechanics Research Association, Temple Fields, Harlow, Essex, to demonstrate the principles of a system of automatic control based on the use of air pressure. Information concerning this system was provided in a translation by P.E.R.A. of an article originally published in Russian by I. I. Ivlicher and E. M. Nadshafor, and it is stated that pneumatic controls based on this system are employed, for example, in steel rolling mills for preventing variations in the thickness of rolled strip. Other possible applications of the system include automatic control of aircraft.

The device shown in the figure is described as a pneumatic computer and is arranged to demonstrate multiplication and division, the readings being shown by the heights of columns of mercury with reference to vertical scales. Two cylindrical chambers, indicated at A in the illustration, are sealed by diaphragms which are connected by a beam attached to a block whereby two air jets

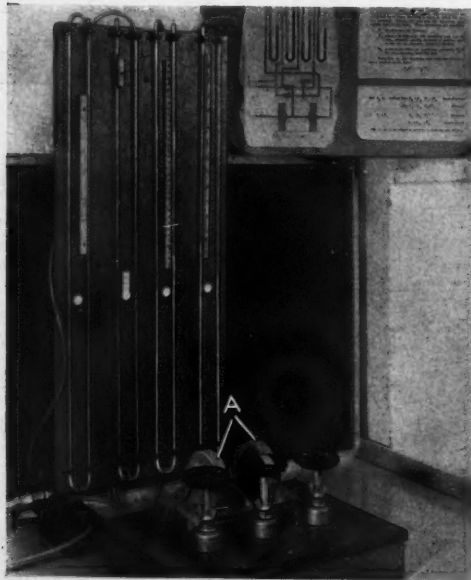


Fig. 1. Demonstration model of the pneumatic computer

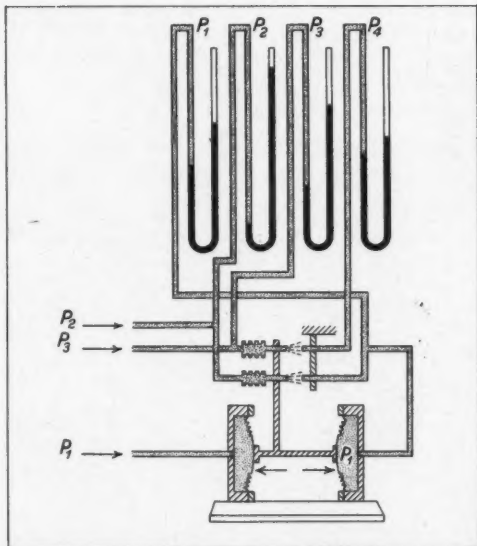


Fig. 2. Diagram showing the circuit of the pneumatic computer as arranged for multiplication and division

are supported. Two receiving pipes, fixed rigidly to the base of the apparatus, are fed with air at different pressures from the jets, as shown in the diagram in Fig. 2, and relative movement occurs in a horizontal plane between the jets and the receiving pipes until a force balance is obtained. The three knobs seen in front of the diaphragm chambers are manipulated in order to vary pressures  $P_1$ ,  $P_2$  and  $P_3$ .

$P_1$  pressurizes one chamber.

$P_2$  passes through a jet and receiving pipe into the other chamber and causes the beam to move to a position in which both chamber pressures are in balance.

$P_3$  is fed to the second jet and produces a pressure,  $P_4$ , in the corresponding receiving pipe.

Both jet and receiving pipe units being similar in size a force balance shows that

$$P_2/P_1 = P_3/P_4$$

Let  $P_2$  be constant then  $P_4 = K_A \cdot P_1 \cdot P_3$  for multiplication,

$$\text{and } P_3 = K_B \cdot P_4/P_1$$

for division.

If  $P_1 = P_3$ , then  $P_4 = K_A P_1^2$  for squaring,

therefore  $P_1 = K_D \sqrt{P_4}$  for square roots.



## Application of an NRC Electron Beam Welder in Bellows Production\*

SUCCESSFUL APPLICATION of electron beam welding to a variety of high precision instrument-type bellows, it is stated, has enabled Metal Bellows Corporation, Wellesley, Mass., U.S.A., to increase production on some assemblies from 10 to 80 pieces per hour. In addition, a number of steps in fabrication has been eliminated, and the quality of the product has been improved. These bellows are required primarily for airborne devices and missile assemblies, and uniformly high quality is of great importance.

An example is afforded by a pressure-sensing bellows used in the fuel control system for the J57 Pratt & Whitney jet engine. For this particular application, a duel bellows is employed, one element of which senses the discharge pressure in the after-burner. The other element is evacuated and provides an altitude reference, and together they automatically adjust fuel flow to ensure the best performance.

\* Abstract of an article originally published in *NRC Vacuum Microcicle*, and reprinted in *The Wild Barfield Heat Treatment Journal*.

Previously, the bellows assembly incorporated a top plate with leadscrew, locating pin, and a tube used in evacuating the bellows. Attachment of the tube, and evacuation of the bellows proved to be a bottleneck in the production cycle. To ensure a vacuum-tight seal, it was necessary to finish-machine both the end of the tube and the hole in the plate. The tube was then brazed to the plate. After the bellows and plate had been welded together, the bellows was evacuated through the tube, and the latter pinched off. To reduce the possibility of leakage, the pinched-off end was soldered.

There was, however, no guarantee that a positive seal had been made during pinching-off and soldering. Only later, during performance testing, was it possible to detect leaking bellows. To re-claim an assembly it was necessary to machine the bellows off at the trunnion mounting, remove the end fitting, drill out the tube, substitute a new bellows, and repeat the remaining stages of the operation again. Under such conditions, the

maximum rate of production obtained was 10 assemblies per hour.

The problem has been solved by the installation of a type 2405 electron beam welder supplied by the Vacuum Division of the National Research Corporation, Cambridge, Mass., U.S.A., and a close-up view of the set-up in the chamber is given in Fig. 1. Since an electron beam welder operates under vacuum, the bellows are evacuated at the same time as the welding chamber, and no special tubes are needed. The only machining required, therefore, is the drilling of an evacuation hole in the end plate. Bellows assemblies are located in fixtures on the work-table, with the holes vertical, and they are moved in turn beneath the beam, which fuses the sides of the hole together.

With this technique, production has been increased to between 50 and 60 pieces per hour, and a five per cent reduction in the cost of an assembly has thus been achieved.

02



Fig. 1. Close-up view of a work fixture for holding bellows assemblies in the NRC type 2405 electron beam welder



Fig. 2. Fixture for holding a dual bellows assembly in the NRC electron beam welder

In addition, because of the freedom from porosity of an electron beam weld, leakage of a bellows assembly is now very rare. Another advantage is the elimination of the stub of the evacuation tube, which formed a weak point and took up valuable space in the control mechanism assembly.

This particular bellows is made from 410 stainless steel (B.S. En. 56B) and it is required to be accurate within 0.5 per cent linearity (pressure versus force output), with hysteresis not exceeding 0.25 per cent. The company originally installed the electron beam welder specifically to solve the problem of evacuating and sealing this bellows. Other uses, however, have been found for the equipment, for instance in connection with the dual bellows seen in the fixture in Fig. 2. This assembly compensates for changes in the volume of the fluid used to fill inertial guidance gyros, and is made by spot welding two precision bellows to a common baseplate. The bellows are of 0.003 in. thick Inconel, and the plate of 0.006 in. thick Inconel.

With earlier silver soldering techniques, distortion and cracking of the bellows resulted in an excessive rejection rate, and the inevitable discolouration shed doubt on the quality of the product. In addition, pre-cleaning to remove surface oxides, and subsequent cleaning to remove

flux, were required. With electron beam welding, there is no distortion and no variation in joint quality or strength on account of differences in operator skill. The saving in time is also important, and amounts to approximately 80 per cent of that previously required for the joining operation.

Another application is concerned with the spot welding of a temperature adjustment stud in the housing of an accelerometer bellows, whereby cracking problems encountered when the assembly was soldered have been overcome.

In addition, the electron beam welder is used as a heat source for brazing operations on nickel and Microbraz, and for copper brazing stainless steel parts. The process eliminates the need for flux since the low operating pressure in the welder removes surface contaminants and prevents oxide formation. Also, heating is confined to the area of the braze. It is pointed out, however, that the process is relatively slow as compared with inert-atmosphere furnace brazing or other production processes, when batch quantities of 1,000 pieces or more are to be handled. The company, therefore, applies electron beam brazing only to prototype development work.

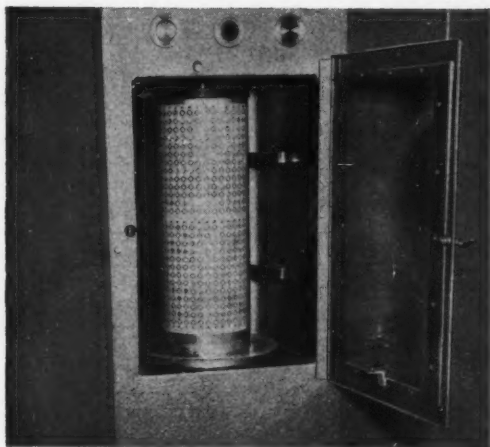
The welder employed is a medium voltage type, employing a maximum of 20,000 volts, and it incorporates a magnetically-focused electron beam gun which is remote from the work area. The operator can readily change current and voltage settings on the master control panel, and adjust the beam focus to suit welding requirements, or set it out of focus for brazing. Attention is drawn to the importance of efficient work holding fixtures to enable maximum output to be obtained from this equipment.

Wild-Barfield Electric Furnaces, Ltd., Otterspool Way, Watford-By-Pass, Watford, Herts., are licensed to build a range of equipment to the designs of the National Research Corporation.

**MALLORY 73 BERYLLIUM COPPER WITH BERYLLIA FREE SURFACES.**—Johnson, Matthey & Co., Limited, 73-83 Hatton Garden, E.C.1, announce that all Mallory 73 beryllium copper strip up to 0.025 in. thick will in future be supplied with beryllia-free surfaces. The mechanical properties of the alloy will not be affected, but tool wear will be reduced. It is pointed out that this hard and abrasive oxide of beryllium is formed during the solution heat treatment of the alloy. The oxide is colourless and is not removed by normal cleaning or pickling methods. By a new process developed by the company, it is stated, beryllia is completely removed.

## Seen at Brussels

Some Close-up Views of Exhibits at the 7th European Machine Tool Exhibition

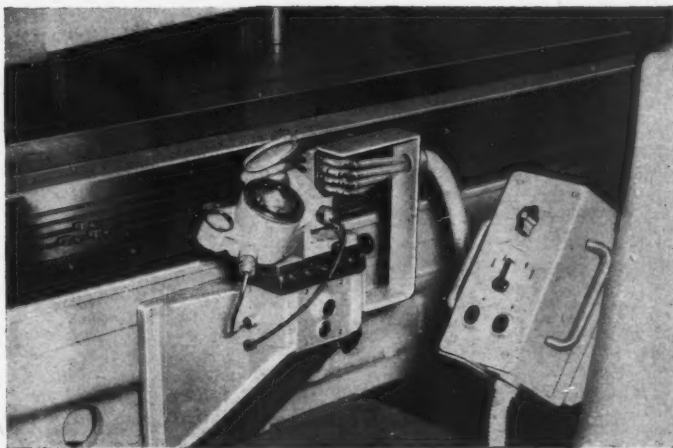


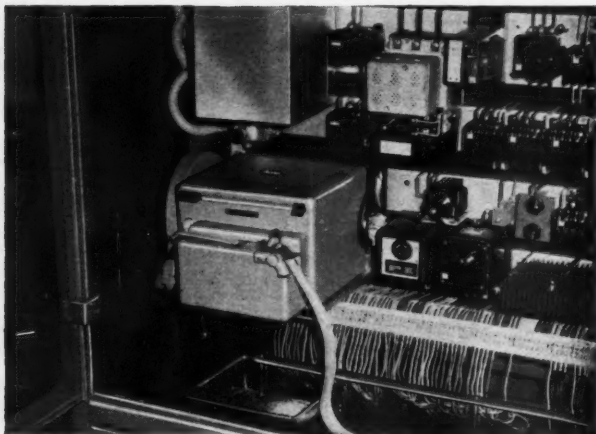
German-built punched-card programming equipment was employed on a number of machines, and a close-up view of the card reader is here shown. The card is wrapped round a vertically-mounted indexing cylinder, and its surface is probed by a number of plungers, as seen at the left. When the plungers encounter holes in the card, they pass through the latter and make contact with the drum. Electrical circuits are thereby completed to initiate various stages of the machine cycle



The unit here shown was displayed on the Landis-Lund stand and served to demonstrate the new dressing equipment for the company's crankshaft grinders. A diamond-bonded wheel, driven by a small electric motor and mounted in a nearly-vertical position, is carried on a compound slide. The slides are moved hydraulically, under the control of a sheet steel template, and are provided with recirculating ball slideways. It is stated that a total arc of 89 deg. can be dressed

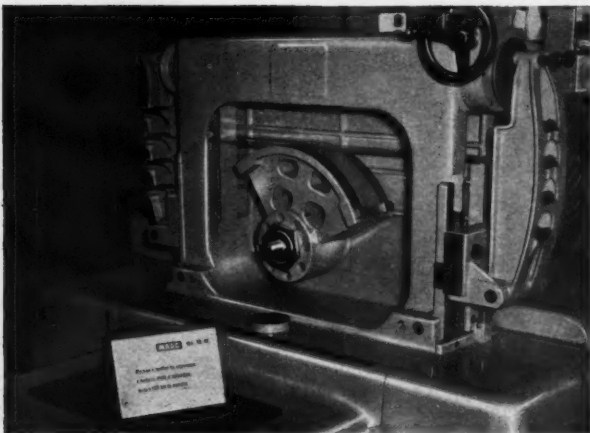
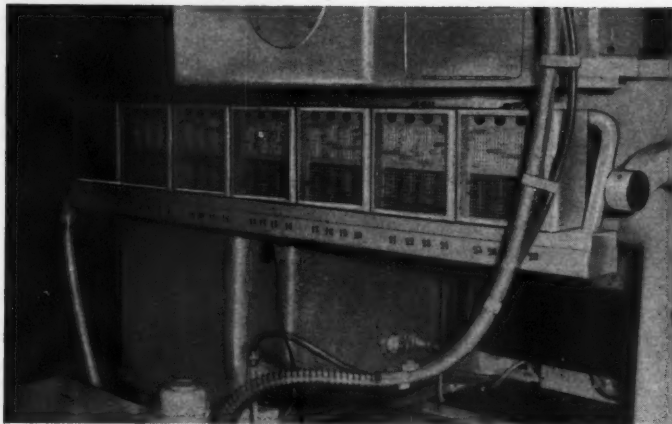
On the Oerlikon Machine Tool Works [Buehrle & Co.] (Dowding & Doll, Ltd.) type RE 3S production jig borer, longitudinal and transverse settings of the table and head are made for the first workpiece of a batch with the aid of optical equipment. At the same time, adjustable dogs are set in slotted bars, as here seen on the table. These dogs serve to actuate Solex liquid-column air gauges, and for subsequent workpieces the operator need only observe the Solex gauges, to check that the slides have been moved to—and locked in—the required positions





A Schaudt type PRS cylindrical grinding machine (Burton, Griffiths & Co., Ltd.) was fitted with this special punched-tape recording equipment. The tape is fed through intermittently at a fixed frequency, and holes are punched at the start and finish of each stage in the automatic cycle. As each component is completed, it is automatically sized, and a hole is punched in the tape to indicate the size within a given range. The tape is subsequently studied by the rate-fixing and quality-control departments

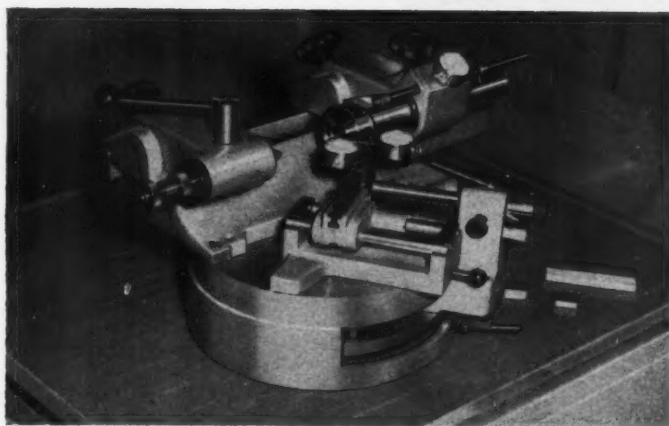
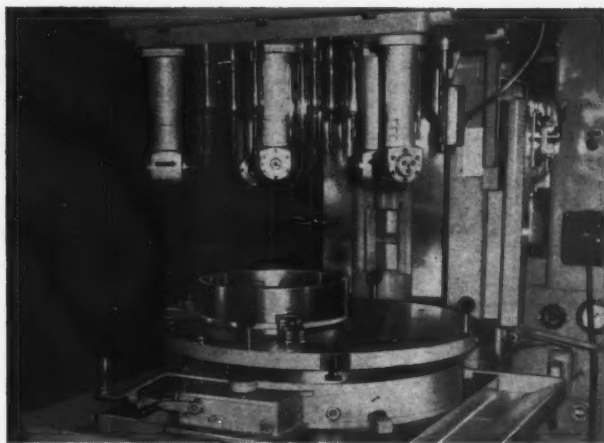
The German-built BEMAG type KBF2 co-ordinate boring and milling machine (Rockwell Machine Tool Co., Ltd.) can be operated under tape or programme control. This view from the rear of the machine shows the seven plug boards which are used for programme control. The plugs are inserted in accordance with the positions of holes in previously-prepared punched cards, which can then be stored for future use



The involute-generating mechanism on the Maag type HSS-60BC gear grinding machine (Burton, Griffiths & Co., Ltd.) incorporates a pitch block and two pairs of steel tapes. These tapes are secured to a special frame, which is carried on the feed slide, and provision is made for tensioning them by means of pivoted arms. The pitch block reciprocates laterally with the work mandrel, to which it is secured. Hydraulic clamping at a pre-set pressure is provided for the pitch block on the mandrel, to obviate the risk of over-tightening and damaging the bearings

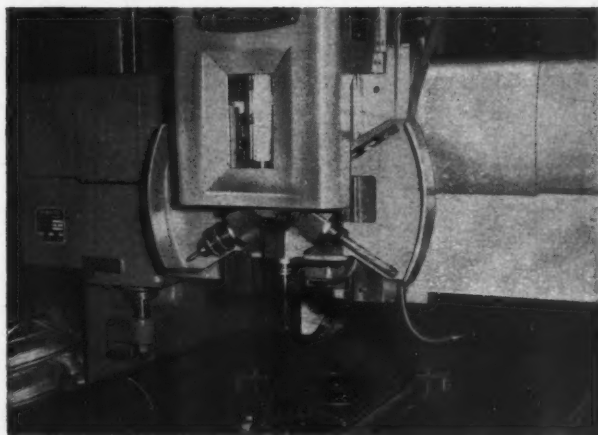


This Burkhardt & Weber (Stuart Davis, Ltd.) multi-spindle head incorporates right-angle drilling, tapping and milling units in addition to the usual vertical spindles. Axial movement of the spindles of the right-angle units is provided, for drilling and tapping. The work is mounted on a rotary table, and core-drilling is carried out at the position shown. Subsequently, the table is turned through 180 deg., to bring the work beneath the right-hand group of spindles, for tapping

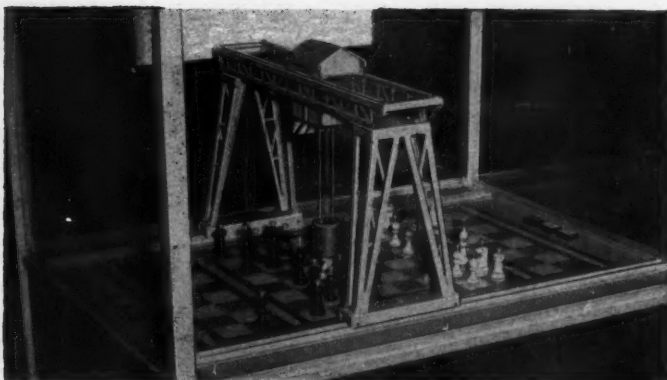


Developed by Jos. Koepfer & Sohne (Sidney G. Jones, Ltd.) the Conotest inspection equipment here shown is set up for checking a bevel gear blank. It enables the edge cone angle, the face width, the pitch cone radius, and the distance from the apex to the rear thrust face to be checked at one set-up. Slip gauges are used to set the angles of the swivelling slides, and dial indicators are applied to the various faces to be checked

The Wadkin/EMI tape-controlled type TCD co-ordinate drilling machine (see MACHINERY 95, 19/8/59) which is now built in three different sizes, can be fitted with a 6-spindle indexing turret head, as here shown. With a maximum drilling capacity in cast iron of  $\frac{3}{4}$  in. diameter, and a tapping capacity of  $\frac{5}{8}$  in. Whitworth, the head has a stroke of 6 in., and spindle speeds range from 116 to 3,000 r.p.m. The turret is indexed under tape control and the machine was demonstrated performing drilling, reaming, counter-boring, and tapping operations on a cover plate

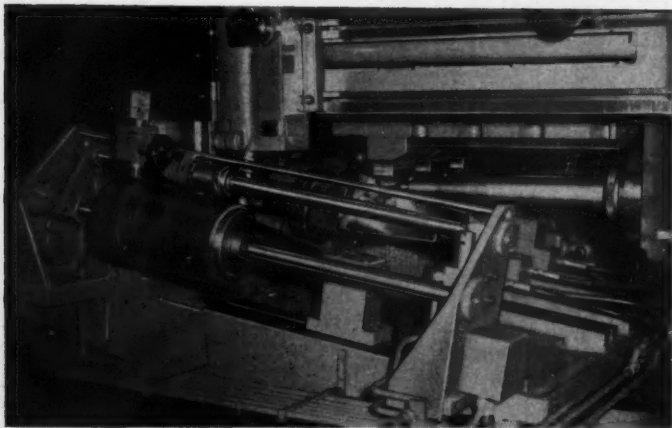






The punched-card programme control system employed on a Wanderer milling machine (Henry Pels & Co., Ltd.) was used to operate this automatic game of chess. Pieces are lifted by an electro-magnet, suspended from a gantry arranged for longitudinal and transverse movements, and coloured lights at each end of the board indicate whether black or white is in play, also when check or "mate" is achieved

This Swiss-built Rigid machine (Dowding & Doll, Ltd.) mills the complete aerofoil portions on three turbine blades simultaneously. The three blades are rotated in synchronism with a master, and the latter is contacted by the roller probe of a hydraulic copying unit, which imparts a rising and falling motion to the cutter head. Drive to the blades and the master is steplessly-variable, and conical cutters mounted on the outboard ends of the spindles are employed



View from the right-hand end of the work-table of the Rigid blade milling machine. A cylindrical cam in the left foreground controls the drive to the work-spindles, and varies the speed of rotation as the cutters approach and leave the leading and trailing edges of the blades. The master blade, and the roller of the copying unit, are just visible behind the cylindrical cam

## NEWS OF THE INDUSTRY

### Cheshire

CRAVEN BROTHERS (MANCHESTER), LTD., Vauxhall Works, Reddish, Stockport, inform us that since our last visit they have received a steady flow of orders for all types of machine tools, of which a substantial proportion has come from the export markets. Machines recently ordered include centre lathes ranging from 18- to 30-in. centre height, and three of the 30-in. machines will have electric profiling and deep-hole boring equipment. Various roll-turning lathes have been ordered, including one of 14½-in. centre height with electric profiling equipment. Grinding machines on order include a 60-in. size for paper-mill rolls, a 24-in. capacity machine for tinplate rolls and a 60-in. capacity cylindrical grinding machine. Orders are in hand for three 25-ft. capacity vertical turning and boring mills; a 150-in. capacity gear hobbing machine; an 8-ft. square self-contained rotary table; a 9-ft. square capacity by 40-ft. stroke planing machine; a special 22-in. roll tenon and wobbler end milling machine; a duplex deep hole boring machine for performing operations simultaneously on two separate workpieces, each 7½-in. diameter by 9-ft. 9-in. long, the maximum boring bar diameter being 1½-in.

Machines seen in the works in the early stages of construction included an ingot planing machine; a 60-in. capacity roll grinding machine; a large sheet polishing machine and a number of standard centre lathes of various sizes. We are informed that the last machines have now been delivered to the Durgapur railway wheel and axle plant, and it was noted that in this shipment there were special waist profiling lathes, semi-automatic solid disc wheel boring and turning mills with electric profiling equipment, axle ending and centring machines, and axle journal roughing lathes. Recently despatched from the works, a new design of 6-in. spindle, travelling column, floorplate-type horizontal boring, facing, milling and drilling machine has dial selection of speeds and feeds, and complete push-button control of all the machine motions with hydraulically operated clamping. This machine was fitted with telescopes for observation of the main setting adjustments from the operator's platform on the spindle slide.

A number of machine tools were undergoing final tests, including some of the patent friction roller drive, profiling wheel lathes; roll turning lathes with profiling equipment; a bar skimming machine; and a 33-in. centre, roll turning lathe, equipped with auxiliary ragging and knurling heads.

THE CROWTHORN ENGINEERING CO., LTD., Atlas Works, Reddish, near Stockport, inform us that they are at present working to capacity producing their range of machine tools, and that their rate of output is only limited by the extreme shortage of skilled labour.

Their order book at present includes centre lathes ranging from 7½-in. to 18-in. centre height; combination turret lathes from 8½-in. to 12½-in. centre height; turning, boring and parting-off lathes for the production of cylinder liners and similar components; boring and facing lathes up to 36-in. diameter swing capacity; and shaping machines of 19½-in. stroke. We are informed that there has been a marked increase in the demand for shaping machines over the past few months, and that orders from technical schools and colleges for the 7½-in. centre lathe are continually increasing. Orders are now in hand from Stow College of Engineering, Glasgow; Dagenham Rushgreen Technical College, Essex; Norwich City College; The U.K. Atomic Energy Training Establishment, Thurso, Caithness; Hastings College of Further Education; Peterborough Technical College; and Coventry Technical College, and it was noted that export orders are in hand from Canada, Guatemala, Central America, Pakistan, Cape Verde Island, Angola, Gibraltar and Mexico.

This company has recently produced two new machines, namely, a 10½-in. heavy duty turning, boring and parting-off lathe, and a 8½-in. combination turret lathe.

New plant installed in the works since our last visit includes a David Brown gear hobbing machine and a David Brown gear shaving machine.

RHODES, BRYDON & YOUATT, LTD., Reddish Works, Furnival Street, Reddish, near Stockport, manufacturers of an extensive range of types and sizes of pumps, report an ever increasing demand for their products for handling acids and other

chemicals, molten metal, also for use with heating and ventilating equipment.

We were informed that the recently introduced S. C. Mopump has been well received. This pump is designed specially for use with packaged boilers, and is capable of generating extremely high pressure heads, while delivering relatively small quantities of liquids.

P. I. CASTINGS (ALTRINCHAM), LTD., Atlantic Street, Broadheath, Altrincham, report an ever-increasing demand for their services as manufacturers of precision castings from an extending number of industries.

We were informed that a new works extension of some 7,000 sq. ft. has now been brought into full operation, and has allowed the company to fulfil the growing volume of orders.

TAYLOR TOOLS & SUPPLIES, LTD., Atlantic Street, Broadheath, Altrincham, are fully engaged on the production of their range of machines and equipment for both the home and export markets. It was noted that the section of the works devoted to the production of work-holding fixtures for use with their various grinding machines is exceptionally busy, and we were informed that this department also undertakes the design of fixtures to suit the customers' individual requirements, if required.

CHARLES S. MADAN & Co., LTD., Atlantic Street, Broadheath, Altrincham, inform us that they are experiencing a good demand for revolving lathe centres, of both standard and the pipe types, from builders and users of centre lathes. It was noted that the range of pumping equipment and air power units manufactured by this company is in very heavy request.

CLARE-COLLETS, LTD., Broadheath, Altrincham, inform us that there has been a notable increase in orders for their full range of patent milling chucks and equipment, in addition to both standard and special milling cutters, routing cutters and end mills. It was interesting to note that the call for milling equipment for plano-milling machines and the heavier floor-type boring machines has shown a marked increase.

BARBER & COLMAN, LTD., Marsland Road, Brooklands, Sale, inform us that they are experiencing a steady call for their range of machine tools from customers throughout the world, and that the new British-built type 6-10 gear hobbing machine has been well received both in the U.K. and abroad.

There is a heavy demand for hobs for cutting gears, ratchet wheels, sprockets, chain wheels, serrations and splines, and it was noted that a con-

stant use is being made of the services of the cutter re-sharpening department.

THE NORTHERN AUTOMATIC SCREW CO., LTD., Golf Road, Hale, manufacturers of turned and screwed components of all types, inform us that they are experiencing an increasing call on their services from an extending range of industries. It was noted that a works reorganization scheme is now in operation. A certain amount of new plant has been ordered, to which we hope to refer in detail at a latter date.

R. SUTCLIFFE.

### Sussex

ALLEN WEST & Co., LTD., Lewes Road, Brighton Sussex, whose engineering activities originated in 1910, continue to be very busy with the manufacture of electric motor control equipment for use in this country and overseas. Official figures show that this company is responsible for the production of almost one-third of such control equipment exported by Britain. Electric motor control equipment is being made for many of the well-known builders of machine tools in the United Kingdom. Control gear for the larger machine tools is frequently enclosed in a separate console or desk, and for other machines it is often possible, by careful design, to house the control equipment inside a column or pedestal, rather than in a separate housing secured to the machine. The Allen West type PB 3 pendant push-button switch unit, it may be noted, was designed specially for machine tool applications. It is provided with a moulded diaphragm interposed between button and switch mechanism to exclude dust, oil and moisture. Extensive alterations and additions to the premises in Lewes Road, Brighton, are in progress, and, when completed, will provide administrative and drawing office accommodation of a superior standard and release the older buildings for other purposes.

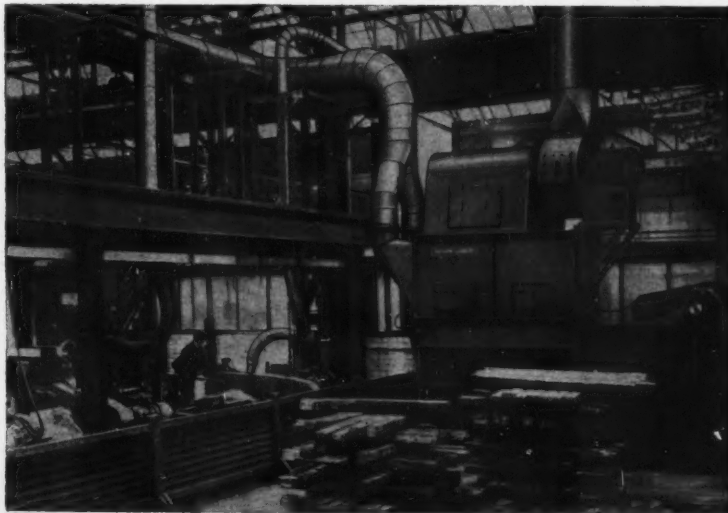
KEARNEY & TRECKER-C.V.A., LTD., Portland Road, Hove, continue to be busy in all departments. Business in the home and export markets is satisfactory, and it may be noted that orders received from overseas have risen considerably during the last year despite increased competition from foreign machine tool builders. There is a good demand for automatics and dieing presses, and the 100-ton press is stated to be attracting much interest. The productive capacity of the body-die section is gradually being enlarged, and the scope of the special purpose machinery section is being increased. An automatic assembly machine, the first of its type to be built by the company, was recently

completed in this department. At the time of our visit we noted many versions of Kearney & Trecker-C.V.A. milling machines, designed to meet the varying needs of industry, in progress through the shops.

C. B. POWELL, LTD., St. Joseph's Close, Old Shoreham Road, Hove, are steadily expanding the production of their Basex range of workshop equipment, which includes an indexing base of simple design for general use in industry or for incorporation in customers' own fixtures. If required, the top plate can be omitted, and the indexing and clamping unit only supplied for further adaptation. The company is also producing a limited range of Basex depth-stop drill holders of various types for use with Morse taper or parallel shank drills. These holders are made to standard dimensions and may be employed, for example, in transfer machining set-ups. The 2,400 sq. ft. of production space in the company's workshops is being fully utilized,



The illustration shows a type MG80 patent wet deduster supplied by Dallow Lambert, Ltd., Thurmaston, Leicester, for dust collection from a battery of swing-frame grinders, some of which are seen in the background. An air displacement of 7,800 cu. ft. per min. is generated by the fan which is powered by a 40-h.p. motor and is mounted on top of the unit. It will be seen that the fan is on the clean air side of the deduster, whence the collected sludge is ejected by a drag link conveyor and deposited in a container on the floor. (Photo by courtesy of Firth-Vickers Stainless Steels, Ltd., Sheffield)



and it is anticipated that an extension to the premises will soon be needed. Special-purpose machines are under construction, also floor-standing test equipment, housed in cubicles, destined for manufacturers of domestic appliances. During the past twelve months, two Colchester centre lathes have been added to the machine tools installed. Full use is made of a Newall 1520 jig boring machine and additional equipment, including an O.M.T. rotary table. The design office continues to be very busy with a variety of projects for industry.

INNS & GROVER (TOOLMAKERS), LTD., 4 College Place, Brighton, 7, are heavily occupied with orders for a wide variety of moulds for plastics, also for press tools, including multi-stage types. This firm has workshops equipped with jig boring machines by Société Genevoise and Perrin, an optical profile grinding machine by Loewe and other precision equipment. A spark erosion machine is installed, principally to meet the company's own requirements, but it is occasionally employed for contract work. Facilities are provided for the production of tools and other parts in tungsten carbide.

TALBOT TOOL CO., LTD., Roedale Road, Brighton, have acquired an additional factory at Hollingbury, Brighton, 6, which provides increased capacity for the production of the well-known "Grip" range of drill bushes. The demand for these bushes is being met, to a large extent, from stocks built up by the company, and it is reported that many orders have been received for bushes with Metric bore sizes. The installation of three 6-spindle Acme-Gridley automatics of 1½ in., 1 in. and 2 in. maximum capacity at the Hollingbury works has added considerably to the firm's output. Heald type 81 internal machines are widely employed for bore grinding, and Myford and Landis grinding machines are used for the external operations, the latter units, which are fitted with Stop Cote size control equipment, being employed on the larger work.

LANCING MACHINE TOOLS, LTD., Commerce Way, Lancing, are receiving enquiries for Nobs rotary gang slitting machines, and auxiliary equipment for



decoding and recoiling strip material. There is also sustained interest in Gfeller pitch-controlled tapping machines and Misa centre lathes. A showroom has recently been provided at the company's premises, and examples of the machine tools for which they hold agencies are displayed, and can be demonstrated under power. At the time of our visit, a 40-ton mechanical press by Rönqvist & Söner A.B., Sweden, was on show. Other machine tools built by this organization include friction screw presses for hot brass stamping, and a range of hydraulic press brakes and guillotines. A type 65 cold roll-forming machine by Comec has recently been supplied to a works in Southern England.

F. W. HERRIDGE.

### **Library for Science and Technology**

The National Lending Library for Science and Technology has now been established at Boston Spa, Yorkshire. Details of the facilities at present available are given in the first issue of *N.L.L. News*, and it is pointed out that industrial buildings are available at the site for the storage of more than 1 million volumes, and that spacious offices and reading rooms have been established.

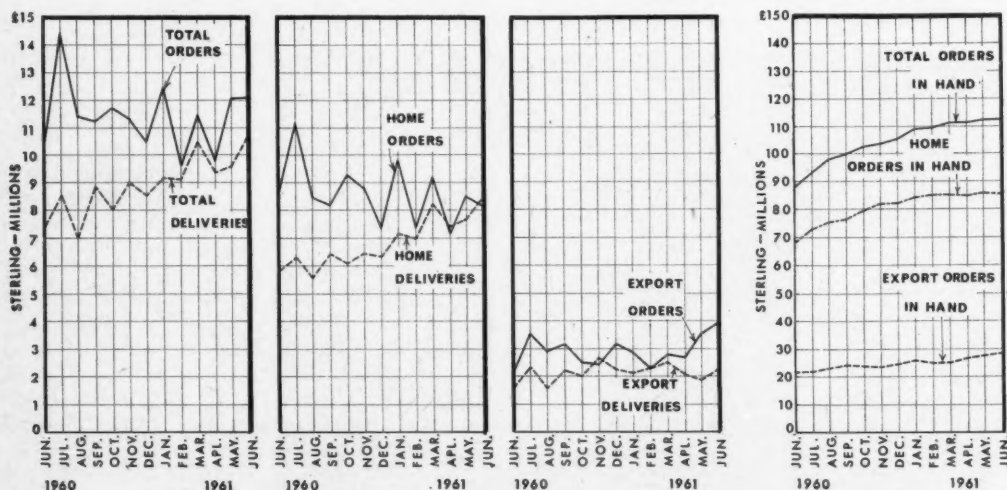
For the past four years, the D.S.I.R. Lending Library Unit has been collecting serial literature of science and technology. This material, and part of the foreign language serial literature from the Science Museum Library, has been assembled at

Boston Spa, and is claimed to form the most comprehensive collection of such literature in the U.K. In addition, various types of literature, previously available from the D.S.I.R. Lending Library Unit are now available from Boston Spa, among which may be mentioned translations of Russian literature, including "cover-to-cover" translations; Russian books; and certain frequently-used English-language periodicals which were on the list issued by D.S.I.R. Lending Library Unit, Stanmore. Requests for the loan of other material, including English language serials (excluding those mentioned above), and books in languages other than Russian, should continue to be sent to the Science Museum Library.

At present, a national loan service is being provided jointly by the Science Museum Library, South Kensington, London, and the National Lending Library, Boston Spa. For the time being, the loan and photocopy form issued by the Science Museum Library will be used by both libraries, and the services of the National Lending Library are available to all organizations that are currently approved borrowers from the Science Museum Library.

It is expected that in about a year the transfer of material from the Science Museum Library will have been completed. A full-scale survey will then be carried out to determine how the services of the National Lending Library can be improved.

Current information concerning the transfer of material to Yorkshire can be obtained from the



The above graphs show the values of machine tool orders and deliveries for the twelve months ended June, 1961, also the values of orders in hand



National Lending Library for Science and Technology, Boston Spa, Yorks., or from the London office of the library, 1 Princes Gate, Knightsbridge, S.W.7.

### **The London Tool (Small Tools) Co.**

Mr. John Brett, who had completed more than 17 years' service with Dowding & Doll, Ltd., as manager of the sales engineering department and manager of the Hob Division, has resigned to take up the position of managing director of The London Tool (Small Tools) Co., Ltd., Fulwood House, Fulwood Place, High Holborn, London, W.C.1, which he recently acquired. This business was established in 1919 as the London Tool & Engineering Co., and was registered as a limited company, under the present title, in 1944.

In addition to the general range of engineers' tools and equipment, the company specializes in the supply of thread forming tools, and has facilities for prompt delivery of special designs. Recently the company was appointed sole distributor in the South and London for the new Rathby carrier and Rathby knurling tools, which are reported to be finding a ready sale.

While not intending to introduce any major changes of policy at present, Mr. Brett is offering a free advisory service on tooling problems, is arranging to increase existing stocks of small tools, and is taking steps to ensure quicker delivery.

Prior to his appointment with Dowding & Doll, Ltd., Mr. Brett was with Wickman, Limited, first as automatic tooling specialist and later as technical enquiry engineer.

### **Improvements in Accuracy of Machine Tool Drives**

*(Continued from page 763)*

has been ruled, the master scale is produced photographically by repeated indexing and printing on a surface coated with emulsion. In this manner, it is stated, not only are short-term periodic errors eliminated, but the time required for the preparation of a typical precision scale is reduced from days to hours.

The contributions that are being made in this field of precision angular measurement and relative speed comparison are typical of the valuable work, of direct industrial application, that is being carried out by the Laboratory. There is no doubt that moiré-fringe techniques can be utilized on a much wider scale than at present, and it is to be hoped that more machine tool builders will collaborate to take advantage of the facilities thus afforded.

### **Industrial Notes**

ALCAN INDUSTRIES, LTD., inform us that their Newcastle-upon-Tyne area sales office has been moved to new premises at Newgate House, Newgate Street (telephone, Newcastle-upon-Tyne 22107).

THE LONDON ASSOCIATION OF ENGINEERS, Elder Cottage, Hurst, Reading, Berks., are inviting students and apprentices, engaged in the engineering industry, to take part in this year's competition for the Junior Challenge Shield. Full particulars can be obtained from the above address.

EUCO TOOLS, LTD., have moved to larger premises in Armfield Close, Industrial Estate, West Molesey, Surrey. The facilities available at this address will enable the company to increase production of micrometer spacers, engraving equipment, and the recently introduced Euco hydraulic vice.

RESEARCH & CONTROL INSTRUMENTS, LTD., 207 King's Cross Road, London, W.C.1, and Sonatest, Ltd., London, W.C.1, have entered into an agreement whereby the former company will market Sonatest ultrasonic non-destructive testing equipment exclusively in the United Kingdom.

BRITISH PRODUCTIVITY COUNCIL inform us that Mr. D. Hardstaff-Mason, M.I.Prod.E., and Mr. C. B. Alers-Hankey, Regional Officers for London and South East (North), respectively, are now at Suite 13, St. Martin's House, 29 Ludgate Hill, London, E.C.4 (telephone City 6335/6).

S. N. BRIDGES & CO., LTD., York Road, Battersea, London, S.W.11, will open new branch premises at 52 West Nile Street, Glasgow, C.2, on October 9. There will be a large showroom and reception counter and a full range of tools will be available for demonstration. In addition there will be a fully-equipped repair and service workshop and stores.

CUNLIFFE & CROOM, LTD., Edward Street, Salford 7, inform us that sales of their range of milling machines, including the recently introduced high-speed vertical milling machine, have greatly increased during recent months, and that a steady flow of orders is also being received for various accessories, including dividing heads. In addition to the standard range this company builds special machines to customers' requirements.

PAYNE PRODUCTS INTERNATIONAL, LTD., Buckingham Avenue, Trading Estate, Slough, Bucks., report that following the sale of two of their improved 48-in. Lap-master lapping machines to the Lancia Company in Italy, for operations on transmission parts, they have received an order for three more of these machines from the same company. They also state that they are receiving an increasing volume of enquiries from motor car manufacturers in other Continental countries.

ROSE BROTHERS (GAINSBOROUGH), LTD., who produce a wide range of Heim Unibal and "Rose" self-aligning spherical bearings and rod ends in the Bearings Division of their Saxilby factory, inform us that between 200 and 300 standard sizes are now in production as well as a wide range of special types. Each unit comprises a single steel ball which can oscillate in a housing of suitable material, for the transmission of motion at varying angles, thus

permitting complicated linkages to be correctly aligned. The company has recently developed a one-piece series of spherical bearing rod ends which are intended for applications where close tolerances are not required and loads are light. Technical information and publications describing these units are available from the above address.

**THE BRITISH OXYGEN CO., LTD.**, Bridgewater House, St. James's, London, S.W.1, have agreed with the Board of Trade to establish, progressively, a new light engineering factory at Dumbarton. Under this arrangement, the production of oxygen plant will still be carried on at the existing Edmonton works. It is estimated that more than two years will elapse before the first stage of the new factory is established, and there will subsequently be a gradual build-up over a period of three to four years.

**THE DIAMOND RESEARCH LABORATORY.**—A folder issued by The Industrial Diamond Information Bureau, 2 Charterhouse Street, London, E.C.1, draws attention to the work that is being done by the Diamond Research Laboratory, which was established in Johannesburg in 1947. Departments of the Laboratory are concerned with physical, chemical, and metallurgical problems, testing diamond drills and grinding wheels, and investigating the production of diamond tools.

### **Personal**

**MR. H. SMITH**, chairman and joint managing director of British Ropes, Ltd., Doncaster, has joined the board of The United Steel Companies, Ltd., The Mount, Broomhill, Sheffield, 10.

**MR. M. MCKENZIE**, **MR. G. TOOGOOD**, and **MR. R. CHAMBERLAYNE**, all of whom are ex-Dowty Group apprentices, have been awarded B.Sc. degrees with first class honours. Two other Dowty Group candidates obtained second class honours. In addition, a Dowty Group student has gained first class honours in the Diploma of Technology, at the College of Advanced Technology, Birmingham.

The following new appointments have been announced:—

**MR. S. BAKER**, M.A. (Cantab.), as general manager of the Machinery Division, and **DR. R. B. SIMS**, Ph.D., B.Sc., M.I.Mech.E., as director in charge of engineering, of Davy and United Engineering Company Limited, a member of the Davy-Ashmore Group, Darnall Works, Sheffield, 9.

**MR. JOHN T. LEWIS** as a director of Staveley Industries, Ltd., 1 Chester Street, London, S.W.1. He has relinquished directorships of two Staveley Group companies, Bradley & Foster, Ltd., Darlaston, and the Birmingham Chemical Co., Ltd., Lichfield.

**MR. R. H. WORMLEY**, formerly Yorkshire area manager, as home sales manager of Associated British Machine Tool Makers Ltd., 17 Grosvenor Gardens, London, S.W.1. The new Yorkshire area manager is **MR. W. G. ORMROD**, who will be operating from Norwich Union Building, City Square, Leeds 1.

**MR. E. L. TUFF**, M.I.Prod.E., director and general manager, as deputy managing director of the Projectile & Engineering Co., Ltd., Thessaly Road, London, S.W.8. He has been with the company for 30 years, and was works manager before being appointed to the board in 1953. He assumed the duties of general manager in 1958.

**MR. W. DAVIS**, with headquarters at 19-20 Grosvenor Street, W.1, as London and South of England representative, and **MR. H. HUMPHSTON**, with office at 33 Exchange Buildings, Birmingham, 2, as Midlands representative for A. P. Newall & Co., Ltd., Woodside Engineering Works, Possilpark, Glasgow, N.2.

**MR. J. R. RYDER**, A.C.G.I., as assistant technical director and **MR. E. SLACK** as sales manager of Thomas Ryder & Son, Ltd., Turner Bridge Works, Bolton. Mr. Slack will have his headquarters in Bolton, and **MR. F. RELPH** will move from the Midlands to succeed him in the London area. The position of Midlands area sales representative will shortly be filled by **MR. D. NEARY**.

**MR. DONALD MITCHELL** as secretary of the Butler Machine Tool Co., Ltd., Mile Thorn, Halifax. Mr. Mitchell has been associated with the company for 24 years, and for the past 10 years has been cost accountant. He succeeds **MR. HAROLD S. MITCHELL**, F.C.A., who will retire at the end of November. The latter was appointed secretary of the company in 1931 and a director in 1951.

### **New B.S.I. President**

At the recent annual general meeting of the British Standards Institution, British Standards House, 2 Park Street, London, W.1, **MR. GEOFFREY CUNLIFFE**, managing director of Norcoros, Ltd., was elected president of the Institution in succession to **MR. R. E. HUFFAM**, to whom tributes were paid for his three years' service. Mr. Cunliffe had earlier been elected chairman of the General Council.

**MR. HUFFAM** was elected a deputy-president, and **Sir Herbert Manzoni** (City Engineer of Birmingham) and **MR. JOHN RYAN** (vice-chairman, Metal Box Co., Ltd.) were re-elected deputy-presidents. **MR. A. D. BONHAM-CARTER** (United Kingdom co-ordinating director of Unilever, Ltd.) has succeeded Mr. Cunliffe as chairman of the B.S.I. Finance Committee, and **Sir Anthony H. M. Bowlby** has been appointed chairman of the Engineering Divisional Council in succession to **Sir Stanley Rawson**, whose term of office has expired.

### **Coming Events**

**INSTITUTION OF PRODUCTION ENGINEERS.** *Doncaster Section.* October 10, at 7 p.m., at The Technical College, Waterdale, Doncaster; lecture on "Cold Extrusion," by **H. A. J. DENNISON.** *Sheffield Graduate Section.* October 16, at 7 p.m., visit to Newton Chambers & Co., Ltd., Thorncliffe, Nr. Sheffield; followed by a lecture on "A Modern Mechanized Foundry." *Birmingham Graduate Section.* October 10, at 7 p.m., at the James Watt Memorial Institute, Birmingham; lecture on "Manufacturing Techniques on the 'Armstrong Whitworth Argosy'," by **R. A. COURTMAN** and **A. W. MENZIES.** *Coventry Graduate Section.* October 11, at 7.30 p.m., at the Courtauld Lecture Theatre, Lockhurst Lane, Coventry; lecture on "Some Future Trends in Machine Tool Design," by **Professor J. Loxham.** *Peterborough Section.* October 11, at 7.30 p.m., at F. Perkins, Ltd., Conference Room, Peterscourt, Peterborough; lecture on "Ball and Roller Bearing Manufacture," by **J. Anderson.** *London Graduate Section.* October 12, at 7.15 p.m., at the

Institution, 10 Chesterfield Street, Mayfair, W.1; lecture on "Can Electrochemical Cutting Compete?" by D. J. Fishlock. *Western Graduate Section.* October 11, at 7.30 p.m., in the Main Lecture Theatre, Faculty of Engineering, Queen's Building, University of Bristol, University Walk, Bristol, 8; lecture on "The Management-Trade Union Relationship in Industry," by S. J. West and P. E. Stanford.

*INSTITUTION OF PLANT ENGINEERS. North East Branch.* October 12, at 7 p.m., at Roadway House, Oxford Street, Newcastle-upon-Tyne, 1; paper on "Management Problems in a Maintenance Department," by T. Gormley. *Edinburgh Branch.* October 10, at 7.30 p.m., at 25 Charlotte Square, Edinburgh; paper on "The Organization of Preventive Maintenance," by D. C. Muirhead, B.Sc. (Eng.).

*INSTITUTION OF MECHANICAL ENGINEERS.* October 11, at 6 p.m., at the Institution, 1 Birdcage Walk, Westminster, S.W.1; paper on "The Design and Manufacture of Cigarette Making Machinery," by Desmond Molins. *Southern Graduate Section.* October 12, at 3 p.m., in the Sports Pavilion, A.W.R.E., Aldermaston; lecture on "Radio Isotopes in Engineering," by W. G. Busbridge.

## Correction

In MACHINERY, 99/696—20/9/61 reference was made to the new fitting and assembly bay at the works of Keighley Grinders (Machine Tools), Ltd., Aireworth Road, Bradford Road, Keighley, and it was incorrectly stated that the area was 5,000 sq. ft. In fact the area of the new bay is more than 9,000 sq. ft.

## Scrap Metals

MIDLANDS.—Recent reports concerning the fall in output of iron and steel explain the lower intakes of scrap by steelworks, blast furnaces, and foundries. Merchants are having great difficulties in disposing of all grades of scrap with the exception of cast iron. In the Midlands, one steelworks has not taken any basic heavy steel for weeks, and others have cut their allocations to a bare minimum.

Prices for steel turnings have been reduced by more than 10s. per ton for the second time in the past few weeks, and merchants are reluctant to handle material except under existing contracts. Bushy turnings in particular are hard to place, and where possible merchants are loading, even at a loss, for markets at some distance, rather than establishing dumps in already overstocked yards. Borings are being cleared regularly, but few consumers will cover merchants for large tonnages over a given period.

Short heavy steel markets are quiet, and allocations are being filled by Monday or Tuesday of each week. Surplus quantities of the lower quality scrap cannot even be loaded for steelworks as No. 3 material on account of the restrictions on acceptances. All grades of cast iron are wanted and prices are inclined to rise by a few shillings per ton for guaranteed deliveries over a period. Light steel and light iron is being moved on a reasonable scale, but destructor scrap is hard to place.

Oversize steel scrap prices have eased, but offers for oversize cast iron for breaking by ball are firm.

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## Trade Publications

LAWES RABJOHNS, LTD., Abbey House, Victoria Street, London, S.W.1. Folder describing the latest design of Admel drafting machine for which a high degree of accuracy is claimed. An endless steel tape transmission is employed.

ROCKWELL MACHINE TOOL CO., LTD., Welsh Harp, Edgware Road, London, N.W.2. Fully illustrated publication describing the three universal (types TU711, TU1020 and TU1042) Matrix machines for grinding parallel and taper threads, with and without relieving. The various constructional features are clearly shown. Another folder is devoted to wheel forming equipment for

Matrix thread grinders, including a multi-ribbed wheel diamond dresser, external manual and automatic multi-ribbed wheel crushers, an external single-ribbed wheel diamond dresser, and an external single wheel generating dresser, also a dresser and a crusher for internal wheels.

ROCOL, LTD., Rocol House, Swillington, Nr. Leeds. Information sheet concerned with Molytox Plus and Molydite Plus varnish coatings for the production of resin-bonded molybdenum disulphide lubricating films on metal and other surfaces. It is stated that Molydite Plus gives a tougher bonding but requires more care in application and must be baked at a fairly high temperature.

## Machine Tool Share Market

Stock markets remained subdued during the period under review, and prices generally moved within narrow limits in most sections, with a tendency to fall.

British Government and similar gilt-edged stocks remained quietly steady for the most part, but finished with a slight setback in values.

Activity in commercial and industrial share markets remained at a low level, and apart from a few firm features due to investment buying, price changes on balance were irregular, with moderate declines predominating.

Among machine tool issues, however, Edgar Allen advanced 3d. to 32s.; Asquith Machine Tool, 6d. to 9s. 6d.; Coventry Gauge & Tool, 1s. 3d. to 31s.; B. & S. Massey, 1s. to 11s. 6d.; Samuel Osborn, 1s. to 49s. 6d.; Sanderson Kayser, 1s. 3d. to 33s. 9d.; and W. E. Sykes "B," 1s. to 25s. 7½d. On the other hand, Geo. Cohen lost 6d. at 10s.; Craven Bros. (Manchester), 1½d. at 8s. 4½d.; Kerry's (Gt. Britain), 3d. at 8s. 6d.; Ambrose Shardlow, 1s. 10½d. at 55s.; John Shaw & Sons (Wolverhampton), 1½d. at 14s. 7½d.; and Tap & Die Corporation, 3d. at 15s. 6d.

COMPANY		Denom.	Middle Price	COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd. ....	Ord. ....	1/-	1/6	Herbert (Alfred), Ltd. ....	Ord. ....	£1	66/6
Allen (Edgar) & Co., Ltd. ....	Ord. ....	£1	32/-	Holroyd (John) & Co., Ltd. ....	"A" Ord. ....	5/-	20/-
	5% Prf. ....	£1	13/6*	"	"B" Ord. ....	5/-	16/3
Arnott & Harrison, Ltd. ....	Ord. ....	4/-	10/6	Jones (A. A.) & Shipman, Ltd. ....	Ord. ....	5/-	25/6
Asquith Machine Tool Corp., Ltd. ....	Ord. ....	5/-	9/-		7% Cum. Prf. ....	5/-	4/6
	6% Cum. Prf. ....	£1	16/6	Kearney & Trecker-C.V.A., Ltd. ....	5% Red. ....	£1	8/9
Birmingham Small Arms Co., Ltd. ....	Ord. ....	10/-	21/-		Cum. Prf. ....	£1	13/9
"	5% Cum. ....	£1	13/-	Kearns (H. W.) & Co., Ltd. ....	Prefd. Ord. ....	5/-	21/3
"	"A" Prf. ....	£1	15/6	Kerry's (Gt. Britain), Ltd. ....	Ord. ....	5/-	8/6
"	6% Cum. ....	£1	15/6	Macreadys Metal Co., Ltd. ....	Ord. ....	5/-	15/-
"	"B" Prf. ....	£1	9 1/2	Martin Bros. (Machinery), Ltd. ....	Ord. ....	2/-	2/6
"	4% Ist Mort. ....	Sek.	9 1/2	Massey (B. & S.), Ltd. ....	Ord. ....	5/-	11/6
British Oxygen Co., Ltd. ....	Ord. ....	5/-	18/-	Newall Engineering Co., Ltd. ....	Ord. ....	2/-	7/-
"	6% Cum. Prf. ....	£1	18/6	Newman Industries, Ltd. ....	Ord. ....	2/-	7/-
Brooke Tool Manufacturing Co., Ltd. ....	Ord. ....	5/-	8/-		6% Prf. Ord. ....	5/-	5/-
Broom & Wade, Ltd. ....	Ord. ....	5/-	27/-	Noble & Lund, Ltd. ....	Ord. ....	2/-	5/9
Brown (David) Corporation, Ltd. ....	6% Cum. Prf. ....	£1	16/-xd	Norton, W. E. (Holdings), Ltd. ....	Ord. ....	2/-	8/-
Buck & Hickman, Ltd. ....	6% Cum. Prf. ....	£1	17/-	Osborn (Samuel) & Co., Ltd. ....	Ord. ....	5/-	49/6
Butler Machine Tool Co., Ltd. ....	Ord. ....	5/-	15/-		5% Cum. Prf. ....	£1	21/9xd
	5% Cum. Prf. ....	£1	12/6	Pratt (F.) Engineering Corporation, Ltd. ....	Ord. ....	5/-	15/-
Churchill (Charles) & Co., Ltd. ....	Ord. ....	2/-	8/10 1/2	Sanderson Kayser, Ltd. ....	Ord. ....	10/-	33/9
Clarkson (Engrs.), Ltd. ....	6% Cum. Prf. ....	£1	25/7 1/2		6 1/2% Cum. Prf. ....	£1	16/3
	Ord. ....	1/-	6/3xd	Scottish Machine Tool Corporation, Ltd. ....	Ord. ....	£1	8/6
Cohen (George), 600 Group, Ltd. ....	Ord. ....	5/-	10/-	Shardlow (Ambrose) & Co., Ltd. ....	Ord. ....	£1	55/-
	4 1/2% Cum. Prf. ....	£1	11/6	Shaw (John) & Sons, Wolverhampton, Ltd. ....	Ord. ....	5/-	14/7 1/2
Coventry Gauge & Tool Co., Ltd. ....	Ord. ....	10/-	31/-	Sheffield Twist Drill & Steel Co., Ltd. ....	Ord. ....	4/-	19/-
"	5% Cum. ....	£1	16/3		5% Cum. Prf. ....	£1	13/3
	Red. Prf. ....	£1	16/3	Stedall & Co., Ltd. ....	Ord. ....	5/-	7/6
Craven Bros. (Manchester), Ltd. ....	Ord. ....	5/-	8/4 1/2xd	Sykes (W. E.), Ltd. ....	"B" non-voting Ord. ....	10/-	25/7 1/2
Elliott (B.) & Co., Ltd. ....	Ord. ....	1/-	2/6xd	Tap & Die Corporation, Ltd. ....	Ord. ....	5/-	15/6
"	4 1/2% Red. ....	£1	12/-	"	4 1/2% Deb. ....	Sek.	8 1/2
	Cum. Prf. ....	£1	12/-	"	1961-1977 ....		
Firth Brown Tools, Ltd. ....	4% Cum. Prf. ....	£1	10/-xd	Wadkin, Ltd. ....	Ord. ....	10/-	26/-
Greenwood & Batley, Ltd. ....	Ord. ....	10/-	16/3	Ward (Thos. W.), Ltd. ....	Ord. ....	£1	70/-
	Ord. ....	5/-	7/10 1/2	"	5% Cum. ....	£1	13/6
Harper (John) & Co., Ltd. ....	4 1/2% Red. ....	£1	11/6xd	"	1st Pref. ....	£1	20/-
"	Cum. Prf. ....	£1	11/6xd	"	5% Cum. ....	£1	20/-
				"	2nd Pref. ....	£1	3/-
				Willson Lathes, Ltd. ....	Ord. ....	1/-	3/-

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. \* Sheffield price. † Birmingham price.



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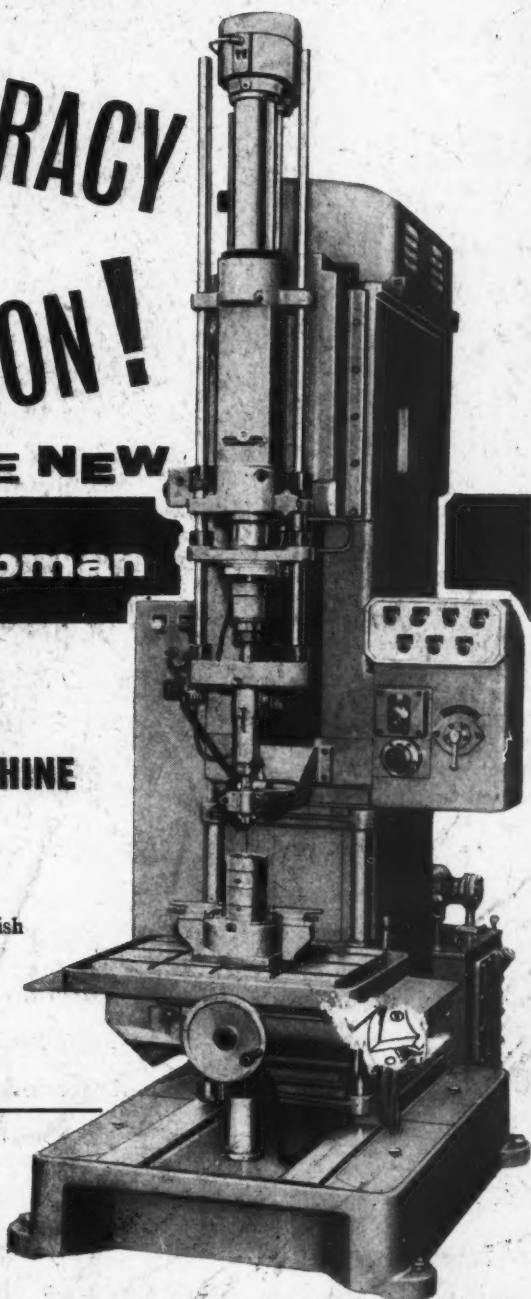
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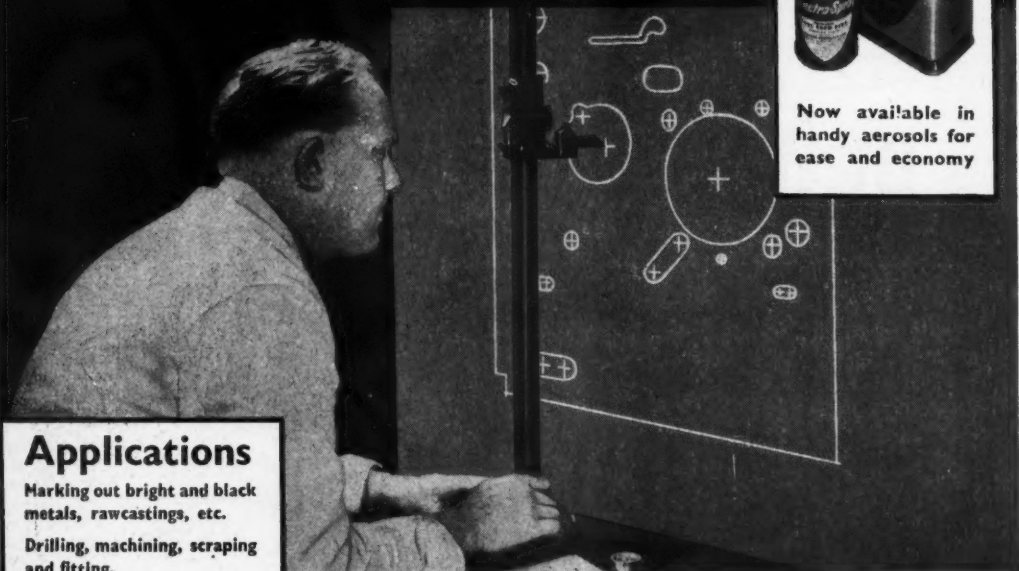


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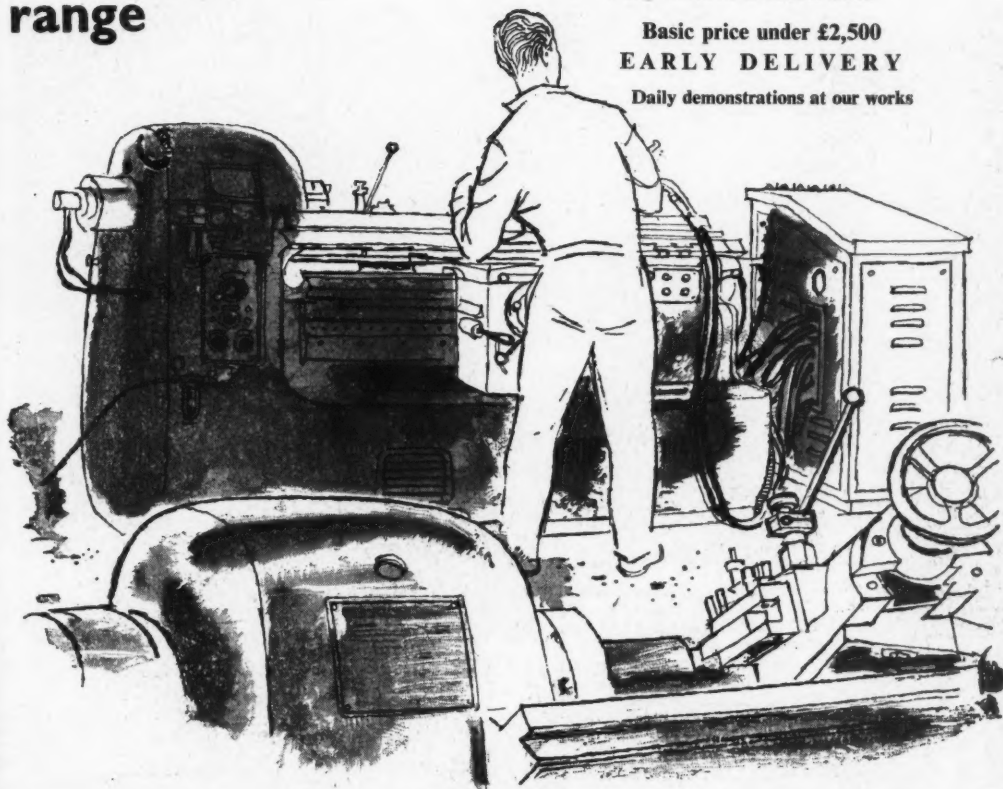
**HYDRAULIC  
PROFILING  
AND COPYING  
LATHES**

**FEATURES INCLUDE :**

- 1 Capacity 14in. by 27in.
- 2 Diplomatic Hydraulic System
- 3 Hardened Bed Slideways.
- 4 Auto cycling up to six depths of cut.
- 5 Hydraulic tailstock for drilling and boring.
- 6 Uses template or existing component.
- 7 Eight models to choose from.

**Basic price under £2,500  
EARLY DELIVERY**

Daily demonstrations at our works



**HERBERT WIDDOWSON & SONS LTD**

Canal Street Works, Nottingham. Tel: 51891 (4 lines). Grams: TOOLS NOTTINGHAM.

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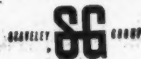
# CIGARETTES AND CUNLIFFE & CROOM MILLING MACHINES



At Molins Machine Co. Ltd., London, leading builders of cigarette-making machines, CUNLIFFE & CROOM horizontal millers help to ensure the Precision so essential for the production of consistently high quality cigarettes. Over fifty of our machines are in regular operation here, and their massive rigidity, ample power, wide speed range and versatility, ensure minimum cost on short runs of one to thirty components.

We build verticals, too, with sliding and swivelling heads. Our catalogue tells the full story. Write for your copy today.

**CUNLIFFE & CROOM LTD.**



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Universal Boring, Facing & Turning Attachment

**\* NOW AVAILABLE WITH QUICK  
POWER RETURN TO TOOL SLIDE!**

3 sizes 8, 12 & 16in. diameter facing capacity

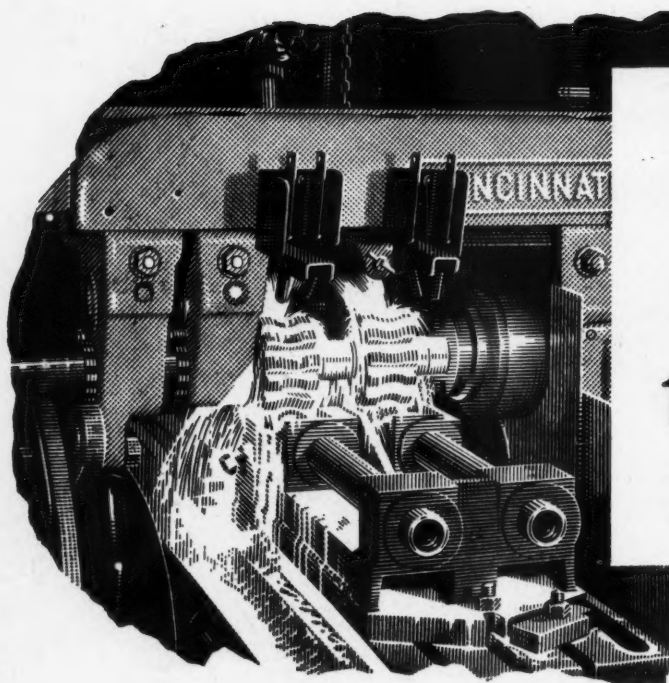
Why not call for a demonstration at our works

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## It's a fight to that finish

These are highly competitive days, when all production effort is geared to one objective—to make an article just that bit quicker, better or cheaper than the next fellow. This worthy motivation leads to profits—production and financial. Something about mousetraps comes to mind but we'll spare you the repetition. Aren't we all machinists anyway? Sometimes, of course, the finish is a fight in itself. Newer materials, unfamiliarity with techniques used elsewhere, switching over to new contracts, turnover of labour—all these factors pose fresh problems to those men in

your organisation who are paid to have production headaches—and solve them. Speaking for ourselves, co-operation is far from being a hollow sentiment at the foot of a letter. Maybe we can help. If you are waging a private joust with poor finish (and losing), leading a personal crusade to improve tool life or just grumbling for the hell of it, maybe we could come in on your particular problem. If cutting fluids can assist in any way, we have a nice string of thoroughbred products, all raring to go and machine trained to boot. After 45 years, we should know our onions — and our production oils. Interested? Then call in the experts.

*choose*

**FLETCHER MILLER**

*cutting fluids*

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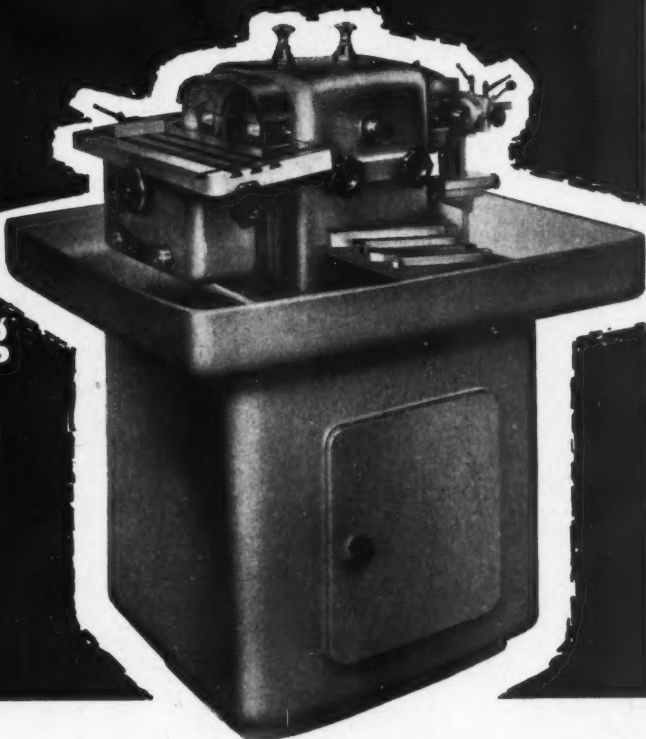
CP135



# LUSCHER

*Made in the finest  
tradition of Swiss  
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## 4 wheel combination carbide tool grinding and lapping machine



### Specification

To take grinding & Lapping Wheels. 6in. dia.

Power of main motor. 1 h.p.

Size of inclinable table. 24in. by 9 $\frac{3}{4}$ in.

*Attachments Available. for Chip Breaker  
groove grinding, Nose radius grinding, twist  
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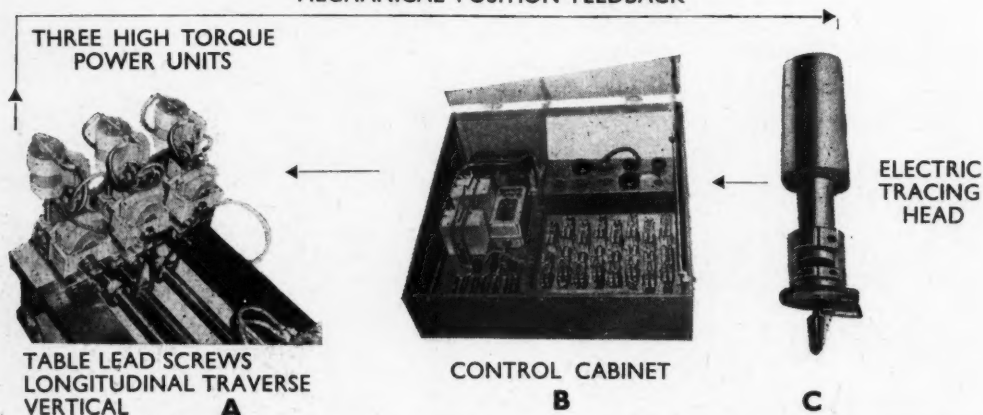
# The HYPROFILE

## ELECTRO HYDRAULIC CONTROL

- A. High Torque Power Units for attaching to the machine feed shafts.
- B. Control Cabinet for interlocked tracer control for one, two or three-dimensional machining with combined 360° profiling with depth control.
- C. Electric Tracing Head for universal copying from models or templates.

For one, two or three-dimensional control attach the power units to the machine feed shafts for copy milling, turning or planing, 360° profiling and three-dimensional machining from models or templates.

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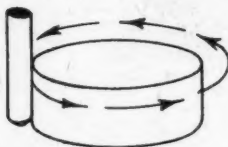


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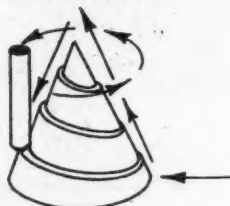
180° Duplicating

### GIVES CAM MILLING



360° Profiling

### COMBINATION



180° & 360° Duplicating and profiling

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Full particulars sent on application

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Telephone: Knottingley 2743/4

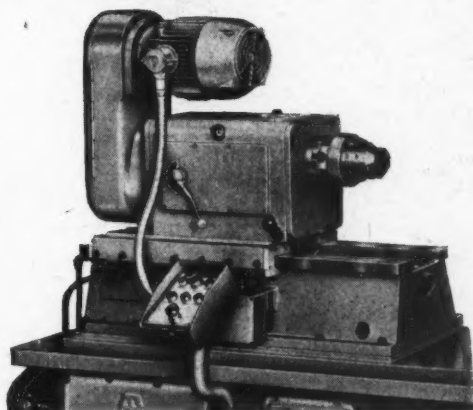
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*A name in Europe synonymous with*

# AUTOMATION

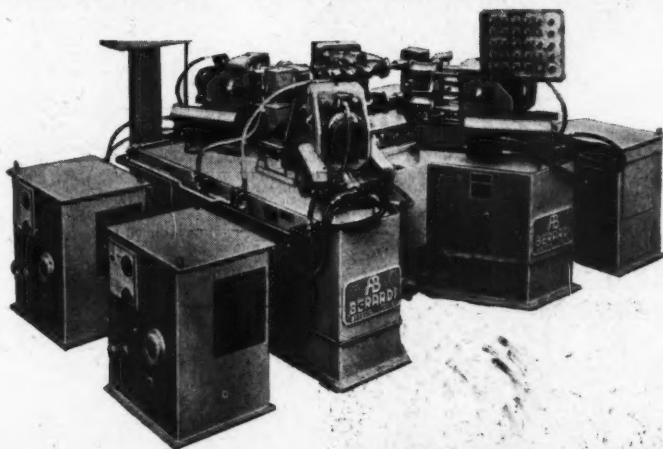
- Electro-Hydraulically Controlled
- Flexibility with standardisation of Units
- Handling reduced to minimum
- Consistent Production



Our Development Engineer always available for discussion

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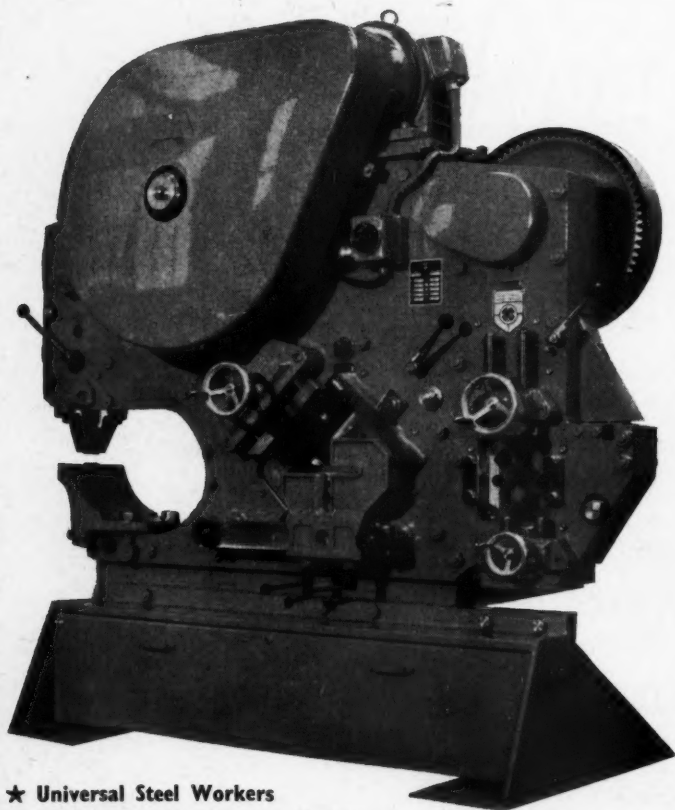
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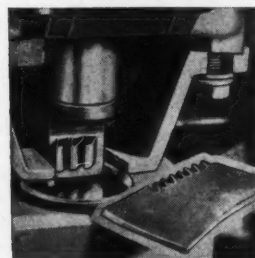
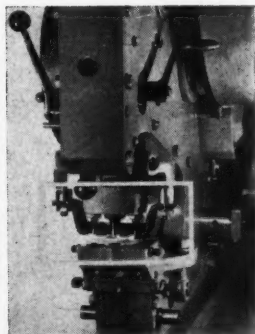


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- ★ Universal Steel Workers
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All the above types are available in five sizes. Inspect these machines at our showrooms. We offer a complete tooling service.



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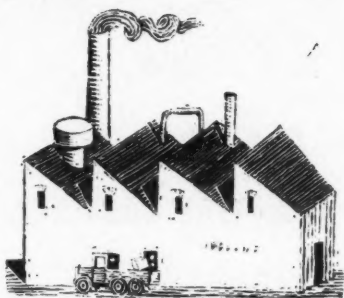
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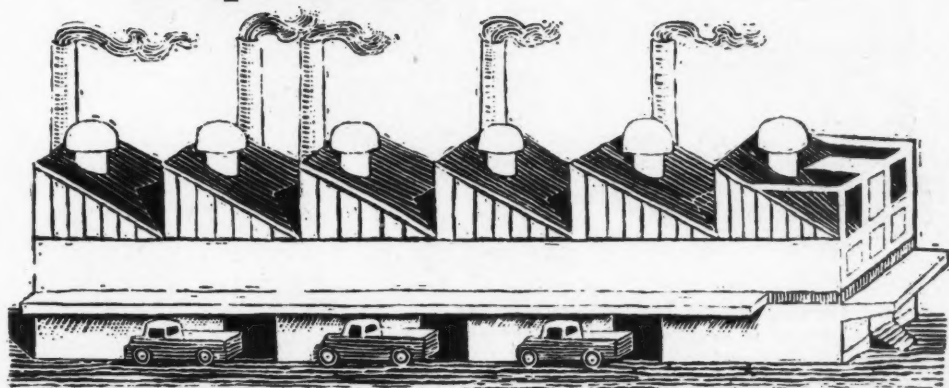


There can be no expansion in a competitive business without the regular addition of the latest machinery and equipment. This is where Mercantile Credit facilities can prove such a vital factor in your development. They enable you to acquire the machinery or plant you need out of income and additional profits, while your essential working capital remains undisturbed.

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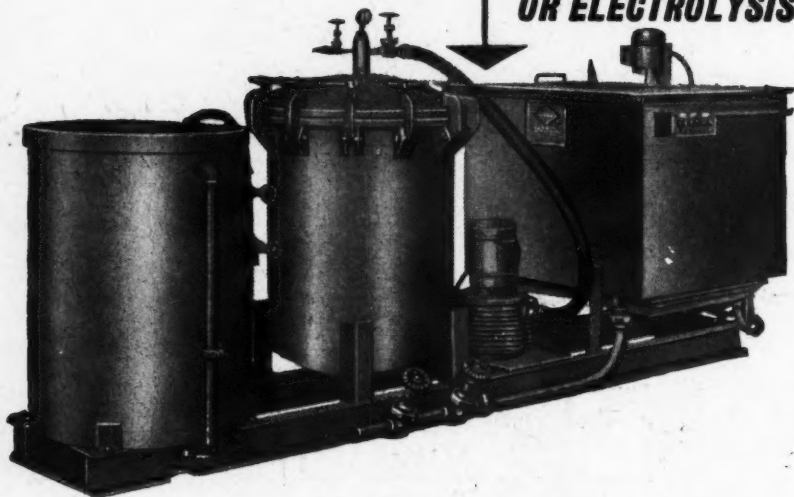
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# *new* Impregnation Process for Porous Castings

**THE NEW MOGUL  
CAST SEAL PROCESS  
IMPREGNATES CASTINGS  
WITHOUT BAKING  
WITHOUT DISCOLOURATION  
WITHOUT RUSTING  
OR ELECTROLYSIS**



The MOGUL CAST-SEAL Impregnating Process utilises a metallic colloidal solution, which is pressurised round and through the castings and permanently seals leaking and porous places. The solution penetrates into the leaks and builds up a metallic seal right through the wall.

Ferrous and non-ferrous castings can be treated in 45 minutes without preparation (other than de-greasing where necessary) and do not require subsequent baking or cleaning. The process does not affect the appearance of the castings in any way.

*An Impregnating service to the trade is operated at Sheffield.*

*Patented by the Metallizing Company of America.*

*Manufactured in France by the RONCERAY Group of Companies.*

**BRITISH RONCERAY LIMITED**  
**14, WOLSELEY ROAD, SHEFFIELD, 8**



Telephone: 54108

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**MEC**

Engineered for Precision and Rigidity

**SAJO MILLING MACHINES****UF52***with Toolmaker's Overarm*

Special Overarm carries Universal Milling Attachment 1 : 1 ratio with normal spindle speeds, thus maintaining maximum height spindle to table.

12 spindle speeds 40 to 1,800 r.p.m.

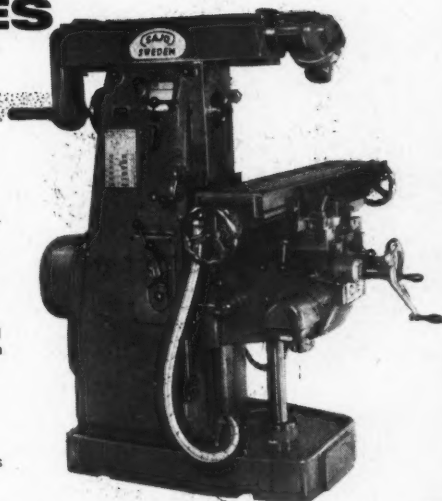
Universal Attachment 1 : 1 ratio.

Working surface of table 41½ in. by 9½ in.

12 rates of feed: 35, 32, 30 in. per min.

3½ H.P. spindle motor, ½ H.P. feed motor.

Also manufactured as standard Universal or Plain Machines and Auto Cycle.

**VF54***Power Feed to Swivel Head*

Head swivels 45° left or right.

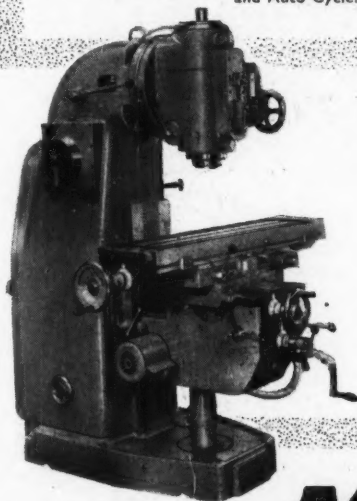
Power feed can be used with head either swivelled or in vertical position.

12 rates of power feed with rapid traverse on all table movements.

Working surface of table 52 in. by 11 in.

7½ H.P. spindle motor, 1½ H.P. feed motor.

Also manufactured as Plain, Universal and Auto-Cycle Machines.

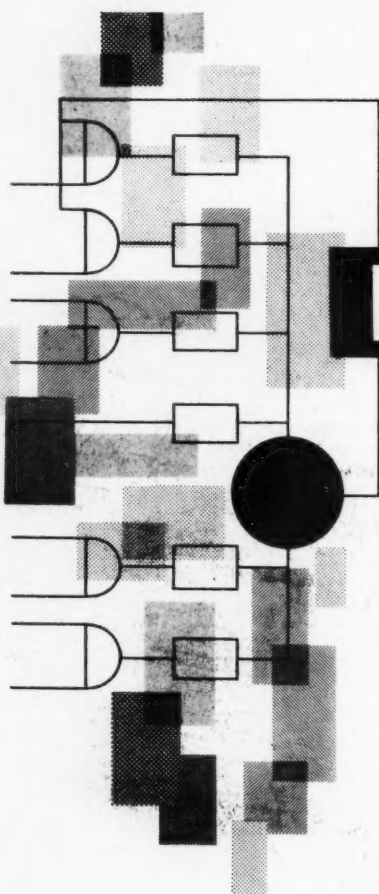


**MORTIMER**  
ENGINEERING Co. Ltd.

MORTIMER HOUSE, ACTON LANE, LONDON, N.W.10. Tel. ELGAR 3834

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# BI-Stat

the  
complete  
switching  
system

BI-Stat controls any automatic sequence of motor operation.

It does anything that electro-mechanical relays can do, without any of their accepted limitations. It will never do wrong. It will never need maintenance. What's more, it is far simpler to modify when the need arises.

#### WHAT IS IT?

A system of logic units and amplifiers, which combine and sort input signals, then magnify them to drive the solenoids, contactors, etc., that initiate plant motions.

#### WHY IS IT BETTER?

Because BI-Stat switching is entirely devoid of moving parts and contacts. Because BI-Stat components are completely encapsulated.

BI-Stat suffers no burn-outs, maladjustment, wear or corrosion, no sticking or fouling or fatigue. BI-Stat works happily amidst dirt, oil, moisture and fumes.

BI-Stat is supplied as BHI-engineered equipment, or as components for your own systems.

Write for publication ZB35 and consult BHI for the BI-Stat answer to your control problems. BI-Stat will solve them permanently.



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MAKERS OF BRITAIN'S WIDEST RANGE OF ELECTRICAL CONTROLS AND ASSOCIATED EQUIPMENT

BI/60

# DE LAVAL TURBO Matic

**FOR THE MOST  
EFFICIENT  
CLARIFICATION  
OF GRINDING  
AND HONING  
COOLANTS**

By the continuous removal of solids, De Laval Turbo-Matic Clarifiers ensure a coolant clarity unattainable by any other method.

The extracted solids, held in the large capacity bowl, are discharged automatically at pre-determined intervals.

De Laval Turbo-Matic Clarifiers can be used for individual requirements, or coupled up as a centralized installation.

Write now for fully descriptive literature  
FACTORY EQUIPMENT DIVISION

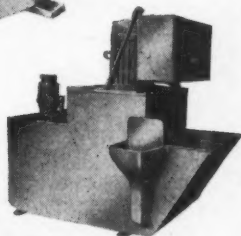
**ALFA-LAVAL  
COMPANY LIMITED**

**DE LAVAL  
TURBO-MATIC CLARIFIER**  
Type BX 215-34S

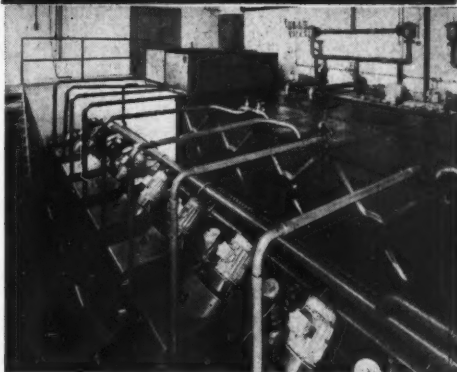


**DE LAVAL  
TURBO-MATIC  
MINOR CLARIFIER**  
Type WX 209-34

*Completely automatic in  
operation and ensures  
uninterrupted flow of coolant*



NINE TURBO-MATIC clarifiers, automatically controlled by a timing device, installed by a large British bearing manufacturer for the centralized treatment of mineral oil.



**GREAT WEST ROAD · BRENTFORD · MIDDLESEX · TELEPHONE: 18Le worth 1221**

*Smee's DL-453*

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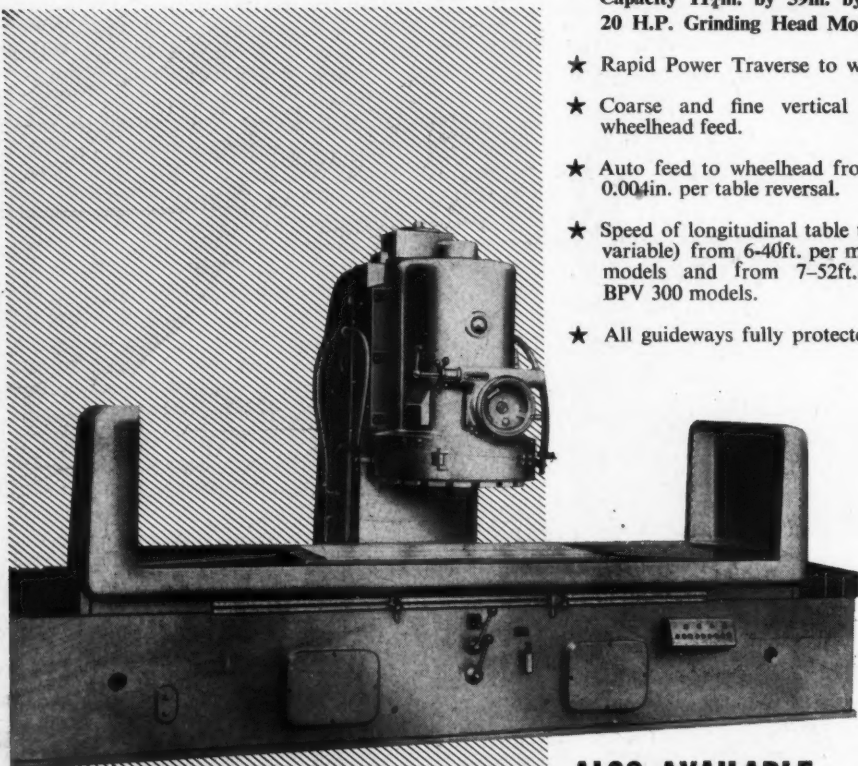
# VERTICAL SPINDLE SURFACE GRINDERS

## FOR EARLY DELIVERY

### MODEL BPV 300/1500

Capacity 11½in. by 59in. by 19½in. Height  
20 H.P. Grinding Head Motor

- ★ Rapid Power Traverse to wheelhead.
- ★ Coarse and fine vertical adjustment to wheelhead feed.
- ★ Auto feed to wheelhead from 0.00016in.—0.004in. per table reversal.
- ★ Speed of longitudinal table travel (infinitely variable) from 6-40ft. per min. on BPV 700 models and from 7-52ft. per min. on BPV 300 models.
- ★ All guideways fully protected.



# TIMES

## ALSO AVAILABLE

### BPV 300/1000

Capacity 11½in. by 39½in. by 19½in. Height  
20 H.P. Motor

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Capacity 23½in. by 118in. by 23½in. Height  
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Exclusive Distributors in the U.K.

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# Beard and Fitch Ltd

*have been makers of the  
finest quality*



*in Clerkenwell, London since 1851*

*In order to meet the increasing  
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production is in progress*

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HARLOW  
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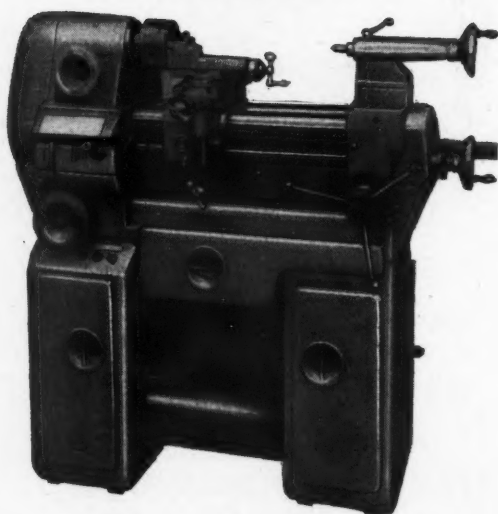
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**Kneller  
Multi-Purpose  
Lathes  
in the  
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Hymatic  
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Redditch**

## **KNELLER MULTI-PURPOSE LATHES**

Although termed lathe, this versatile machine has additional characteristics such as the tailstock unit can be traversed by hand or mechanically with a range of feeds. A vertical movement to the saddle table providing characteristics of a horizontal boring machine, with thread cutting facilities. A facing slide is supplied to perform this operation. This machine is an essential for toolrooms and research departments, where pre-production and small quantities of accurate and intricate machining are required. Also being used in Technical Colleges for educational purposes.



**KNELLER (Instruments & Tools) LTD., LONDON ROAD, DAVENTRY Tel: DAVENTRY 446**

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**For  
More Accurate  
GEARS...**



# VIO

## UNIVERSAL HOBBING MACHINE

An entirely new model built for fast, accurate production. For generating spur gears and sprockets, splines and serrations—and worm wheels by the plunge cut method. Built-in differential for spiralling. Hob head swivels to 60° for left and right hand spirals. Tangential feed hob head available for worm wheels of high tooth angle and worms. Lever operated changeover from roughing to finishing feeds. Rapid return power traverse. Climb or orthodox hobbing methods can be used. A fast production model with hydraulic closed cycle and automatic hob shift is available for mass production of high grade gears.

*Maximum diameter 10"    Face width 8"    7DP*

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full details



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QUALITY STEELS  
FOR BRIGHT DRAWING



**black bars  
rolled  
to close limits**

THE PARK GATE IRON & STEEL COMPANY LIMITED ROTHERHAM

A  Company

TELEPHONE: ROTHERHAM 2141 (15 lines) TELEGRAMS: YORKSHIRE, PARKGATE, YORKS. TELEX 54141

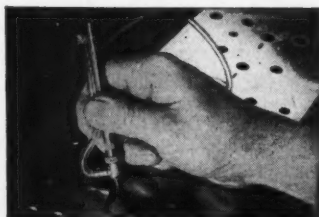
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THE  
**ASHCOMBE**  
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**AIIOTOR**  
 is here!

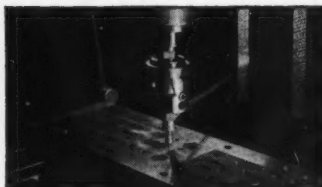
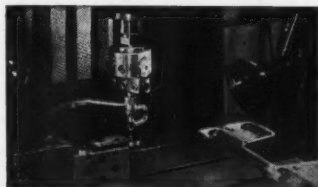


**300,000 RPM**

**A revolutionary industrial tool for ultra high speed removal of metal and other materials to precision tolerances.**



The Ashcombe Airotor is an air-driven instrument operating at a spindle speed in excess of 300,000 r.p.m. This speed develops the full efficiency of small carbide burrs in a field never before used or known. It is possible now to machine the very hardest tool steels, carbides, ceramics, chrome, glass, plastics etc. to close tolerances using inexpensive carbide, diamond and abrasive tools. The high operating speed dissipates all heat from the instrument and from the material being worked, and there is no tendency for the burr to 'climb'. The Ashcombe Airotor can be used as a hand tool, or easily adapted for use with Jigborers, Lathes, Milling Machines, Panto-graphs or in special 'set-ups'. The Airotor head itself is only  $\frac{1}{8}$ " diameter and  $\frac{1}{4}$ " long, allowing the instrument to reach into confined spaces and openings. A full range of tungsten carbide burrs and diamond mounted points are available for use with the Ashcombe Airotor, which can be operated from an airline providing a pressure of 40 lbs. p.s.i.



**W. J. MEDDINGS LIMITED**

SPECIAL PURPOSE DIVISION

IPSWICH ROAD • TRADING ESTATE • SLOUGH • BUCKS

Phone: Slough 26761 (5 lines)

**Sole selling agents in Europe**

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# *allthreads*



The range in both Brass and Steel is from 0 BA to 5 BA and  $\frac{1}{4}$ " to  $\frac{1}{8}$ " diameter and between  $\frac{3}{4}$ " and 4" long. Recommended for use within this range, with rolled threads, where studding in these lengths in cut threads would be too expensive. Please send for stock lists.

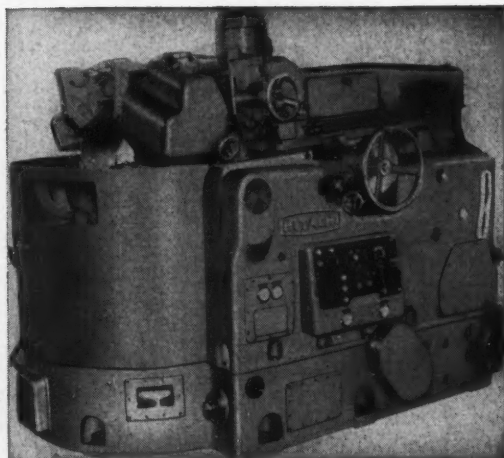
Let ORMOND quote for all Repetition Parts—for single and multi-spindle automatics up to  $1\frac{1}{4}$ " diameter; Brass, Steel and Light Alloy Screws in Rolled and Cut Threads, Grub-screws, Nuts, Hexagonal Bolts and Set-screws, turned from bar and Cold Headed Grades "A," "B" and High Tensile.

**THE ORMOND ENGINEERING CO. LIMITED**

Ormond House, Rosebery Avenue, London, E.C.1. Telephone: TERminus 2888. Telegrams: Ormondengi, Cent

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## Efficiency *plus* **HITACHI** Bevel Gear Grinder



HITACHI Bevel Gear Grinder Type 600 BG-1

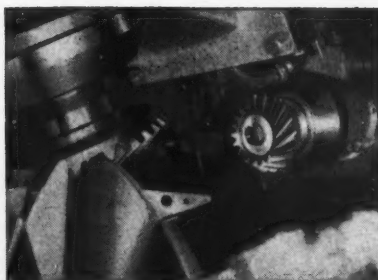
### Characteristics:

The HITACHI bevel gear grinder, Type 600 BG-1, has been designed on an entirely new principle of generating method, and is credited with the following features:—

1. The machine can be operated with utmost ease.
2. Crowning is possible even in the direction of gear teeth.
3. The same grinding wheel can be used irrespective of dimensions, helix angles, pressure angles of the bevel gears to be processed.
4. Meshing tests can be conducted without removing the processed gear.

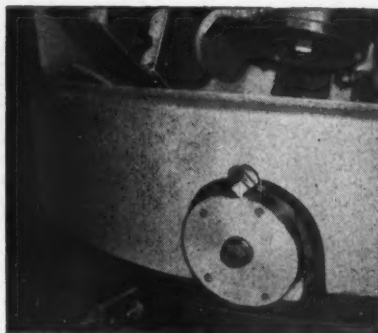
### Specifications:

Max. pitch dia. ....	610 mm.
Min. pitch dia. ....	50 mm.
Largest cone distance ....	305 mm.
Pressure angle ....	14½°—20°
Max. helix angle ....	35°
Module ....	2.5M—8M
Dia. of grinding wheel ....	400 mm.
Main Motor ....	5 h.p.
Size of Machine	2,765 mm. x 2,000 mm. x 1,850 mm.
Net Weight ....	approx. 11,00 kg.



WORK HEAD

The photo shows that a set of gear and pinion is fitted on each work head.



DIAL FOR AUTOMATIC SETTING

The table constructed in the two-stage type, and is provided with a screw for parallel slide and a dial.

### Patents on this grinder:—

Patents have been applied for in the United States, Britain, Germany, Switzerland and Italy, in addition to those already taken out in Japan.

### Other HITACHI products include:—

Gear hobbing machines  
Knee-type milling machines  
Surface grinders  
Roll lathes and grinders  
Railway car wheel lathes  
Axle journal returning and burnishing lathes  
Transfer machines, etc.



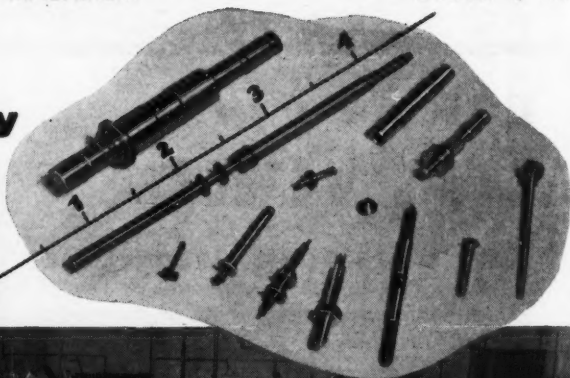
**Hitachi, Ltd.**

Tokyo Japan

Cable Address: "HITACHI" TOKYO

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**... for accuracy  
combined with  
large scale  
production**



**S.SMITH & SONS (ENGLAND) LTD.**

*Use*

# **TORNOS**

**sliding head Automatics**

Ideally suitable for the large scale production of high precision parts — both simple and complex — the TORNOS sliding head automatic with its many special features is unequalled for performance, precision and workmanship. Eight models are available with a stock capacity of 4 to 32 m.m., and details will gladly be sent on request.

**TORNOS SALES COMPANY (E. M. VAUGHAN LTD.) 301 BROADGATE HOUSE, COVENTRY, Phone: 26815. Telex: TORNOS, COV. 31541**

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# CONTINUOUS PRODUCTION ON BEARING RINGS

AT POLLARD BEARINGS LIMITED

## LUMSDEN

MODEL 91-MLN  
**TWIN HEAD  
SURFACE  
GRINDERS**

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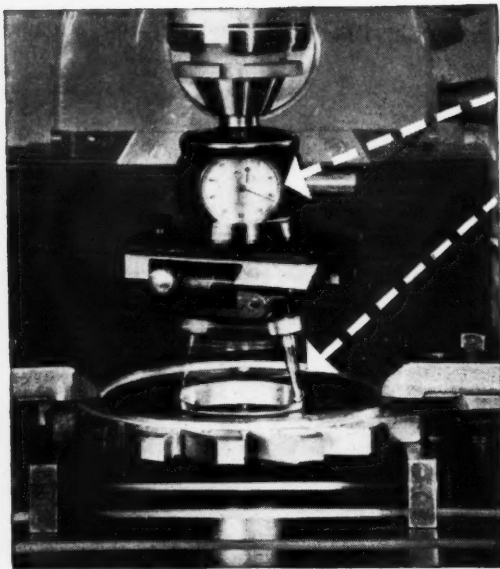


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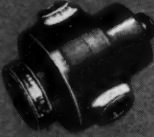


Foot mounted

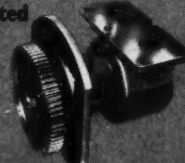
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automatic positioning available

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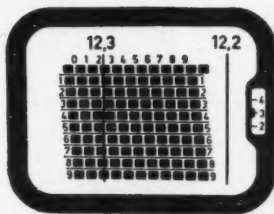
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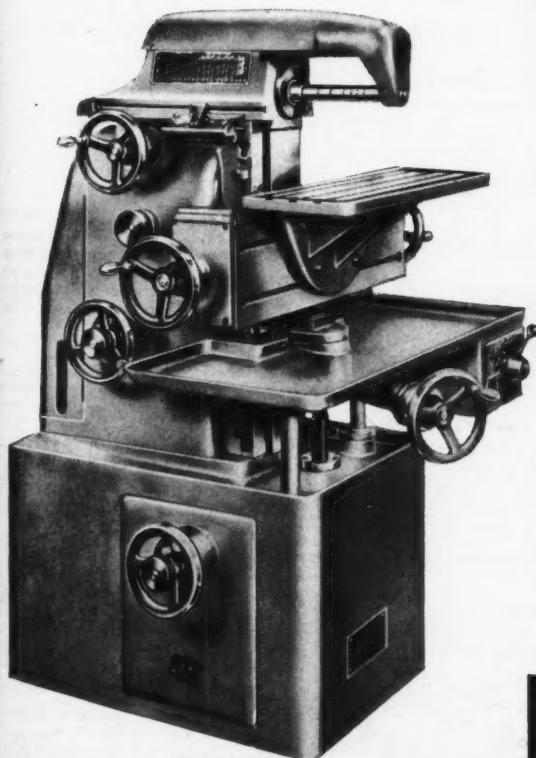
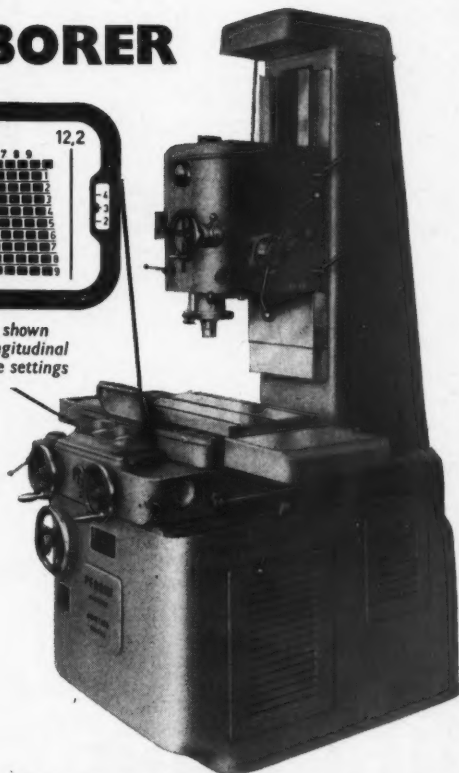
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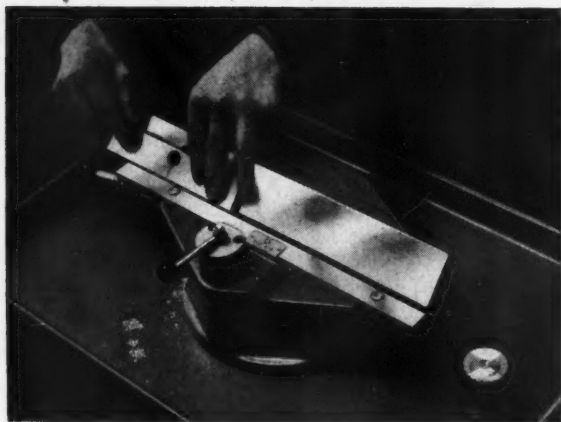
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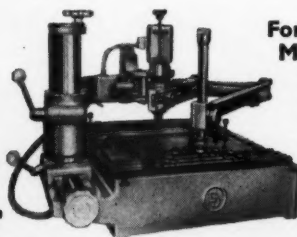
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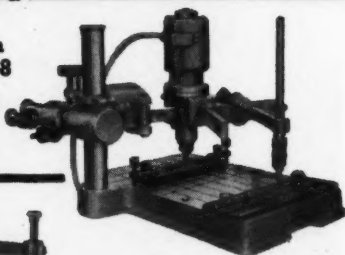


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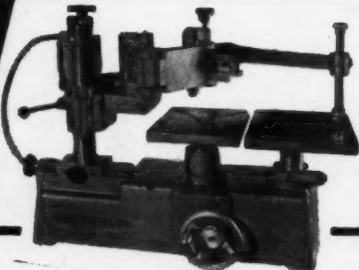
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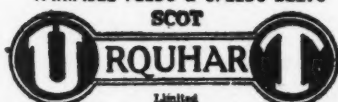
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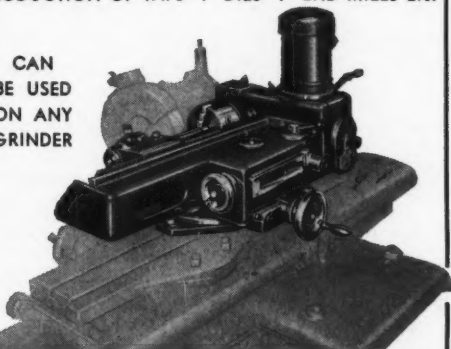
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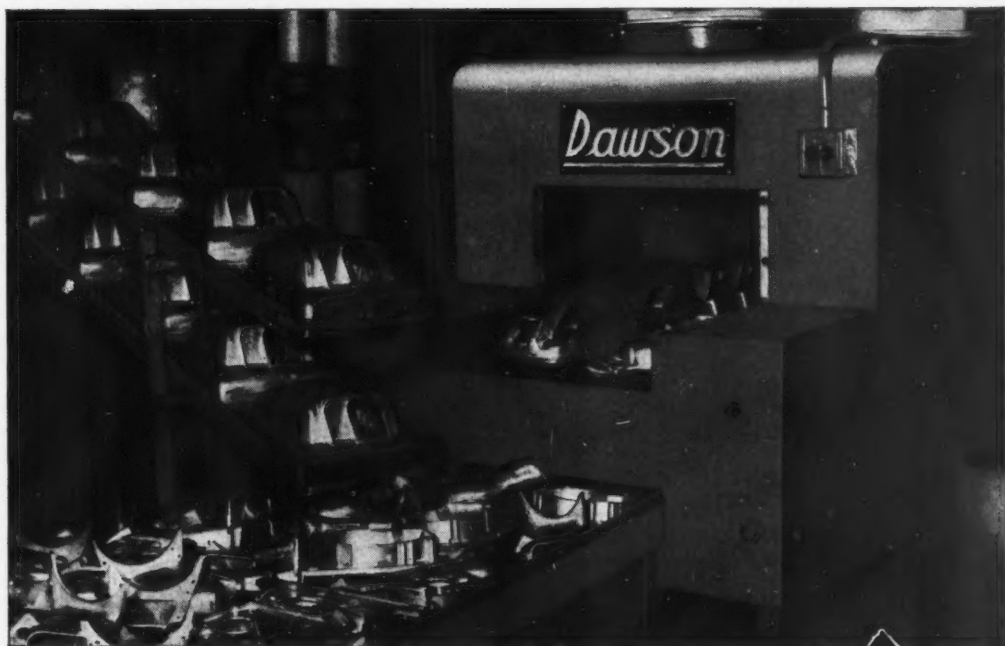
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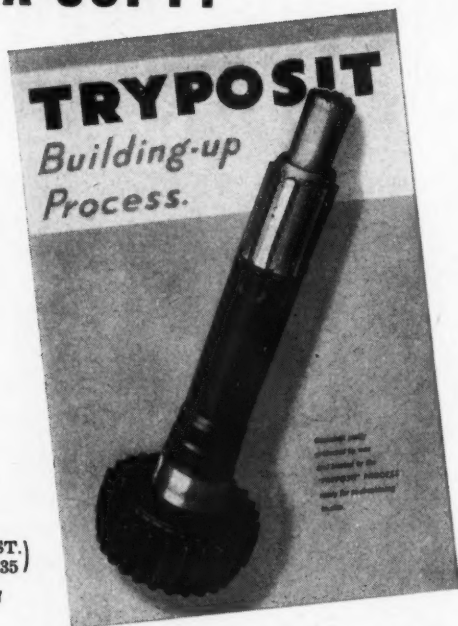
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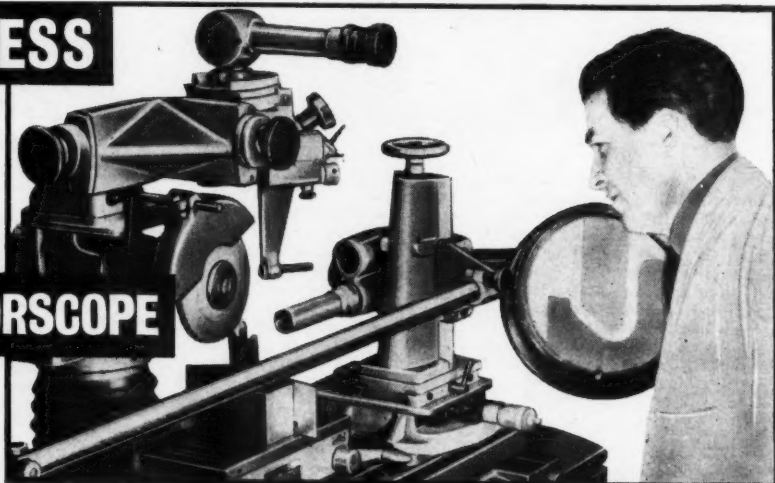
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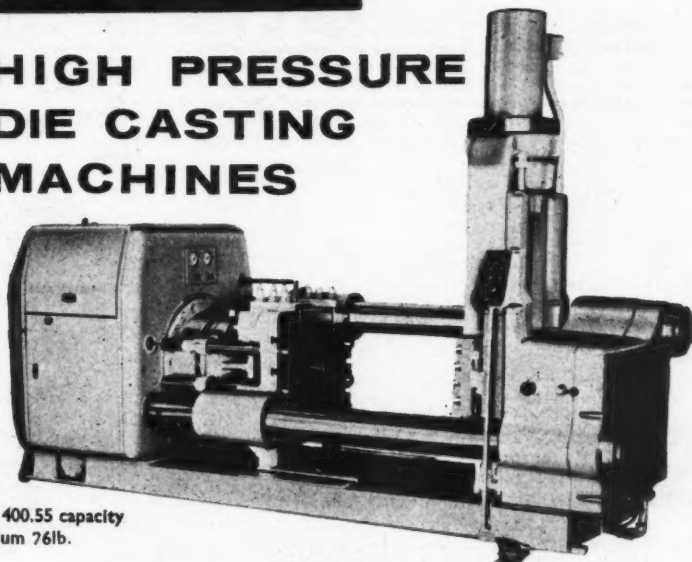
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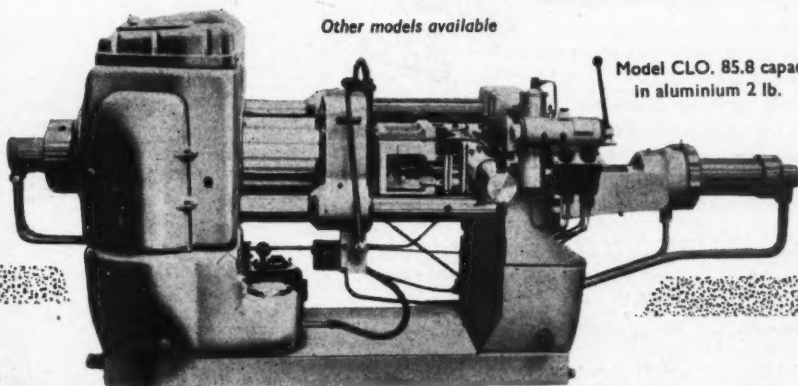
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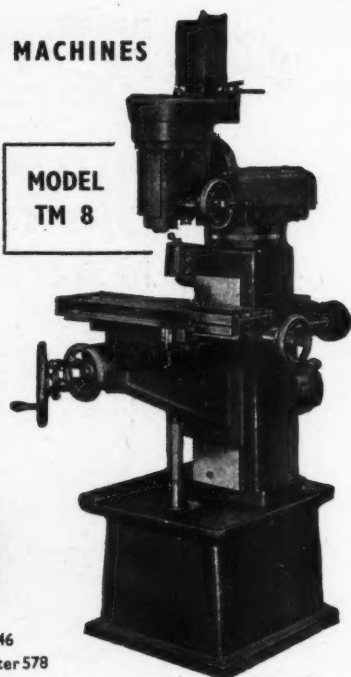
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T.M.10	28in. by 10in.	19in.

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MODEL  
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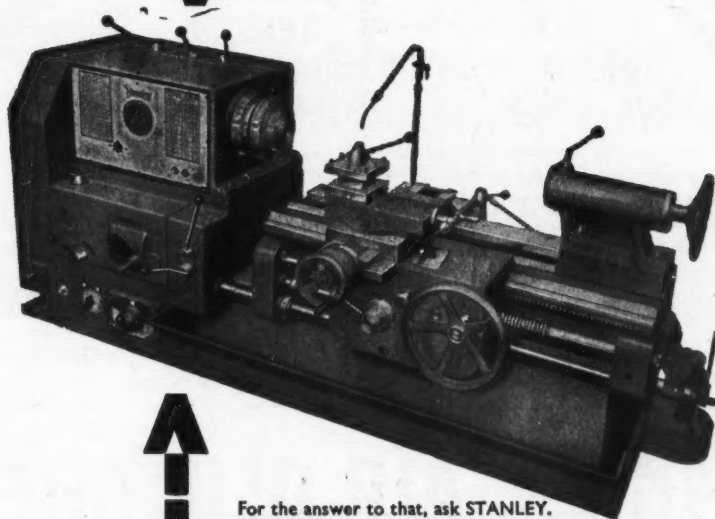
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Small-Bore Gauge  
DIATEST Gauges are the  
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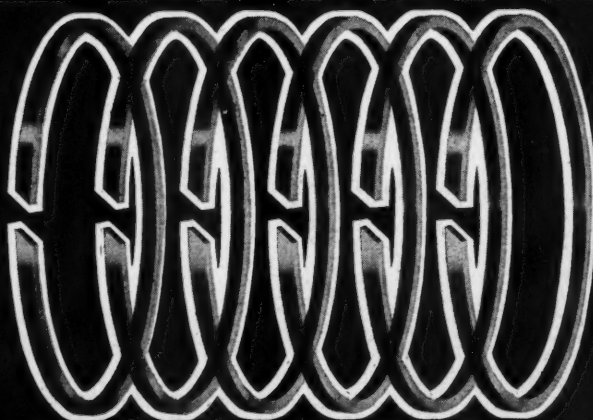
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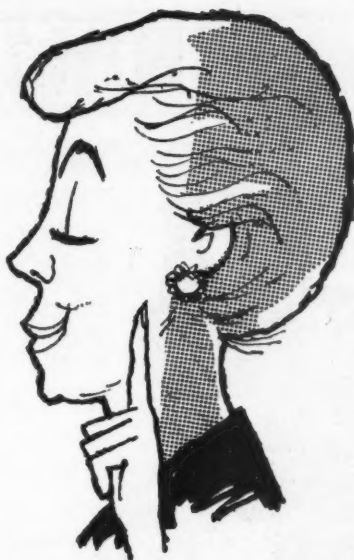
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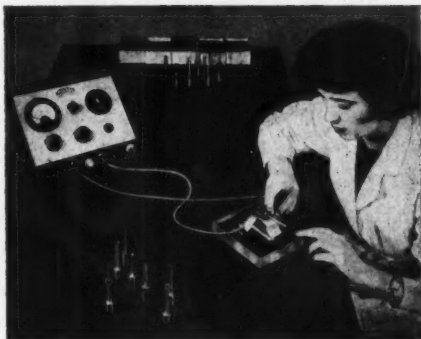
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So often the 'gentle touch' proves the more effective. Indeed sometimes it is essential. Especially when marking parts where the surface structure of the metal must not be disturbed. That's when you need Electrolytic Marking Equipment.

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Electrolytic Marking Equipment affords three inexpensive methods of marking metals quickly, permanently and safely without affecting surface structure.

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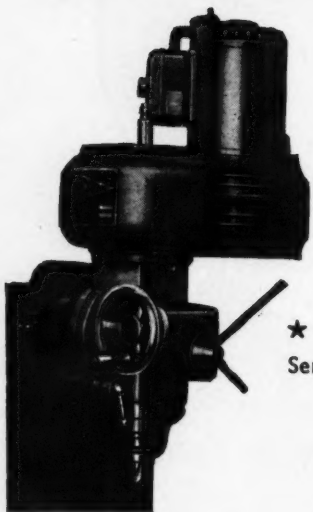
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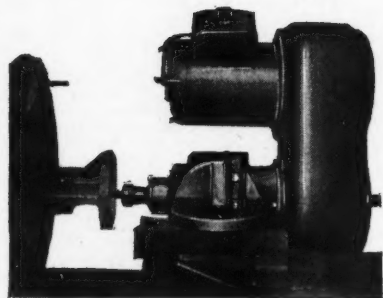
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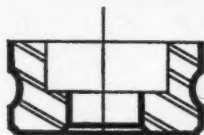
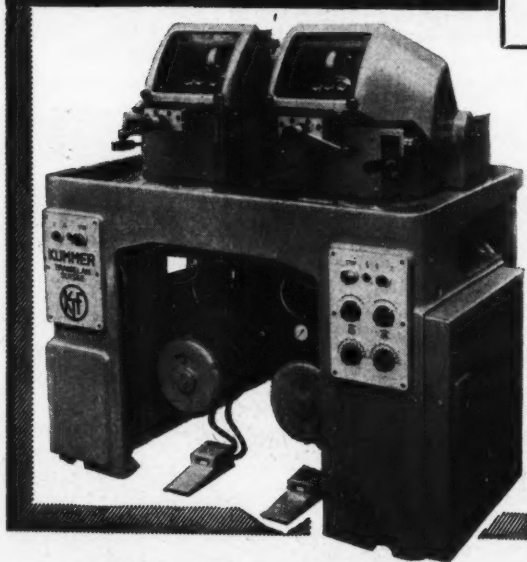
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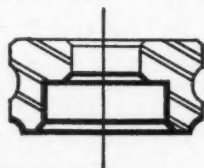
There are many operations where the Kummer K20 can show handsome savings. This is one of many typical examples. Suitable for work on bar, castings, forgings and stampings.

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Operation 1  
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SCALE FULL SIZE



BALL RACE  
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MATERIAL BEARING  
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SPEED = 500 f.p.m.  
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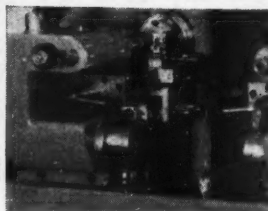


Illustration shows tailstock which is one of the many optional features available.

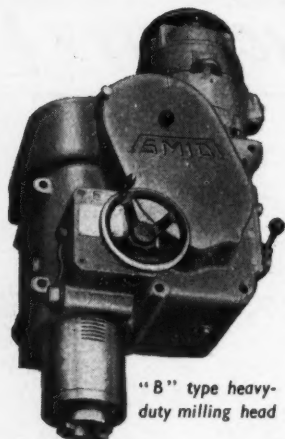
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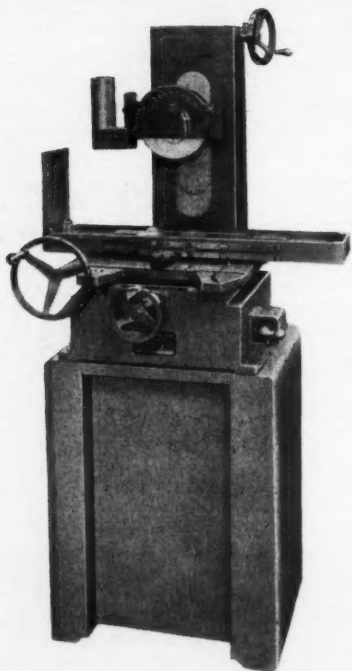
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**MICRO GRINDER MODEL M.G.**

**CAPACITY 8" x 12" x 12"**

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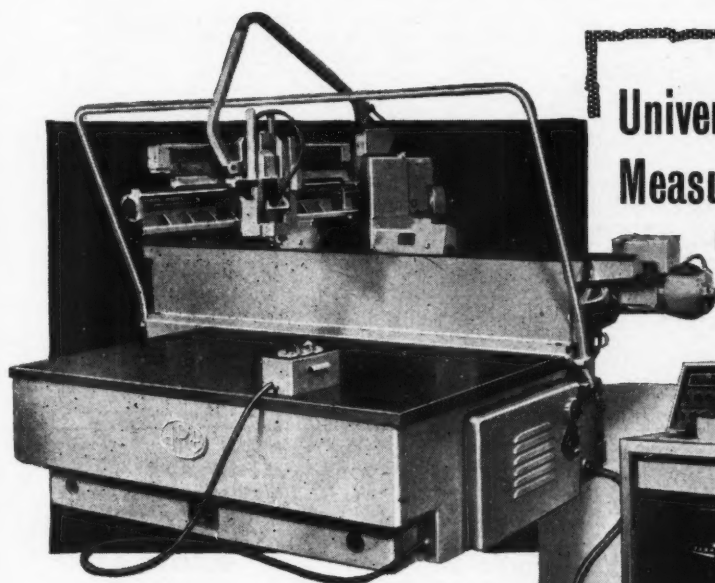
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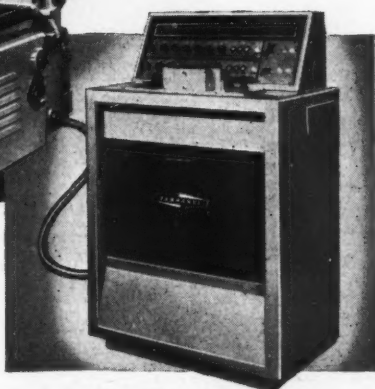
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MODEL A.M. 7236



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**With FERRANTI  
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Fully illustrated details on request



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3 phase only, any voltage.

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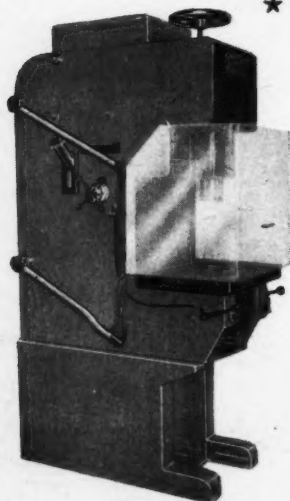
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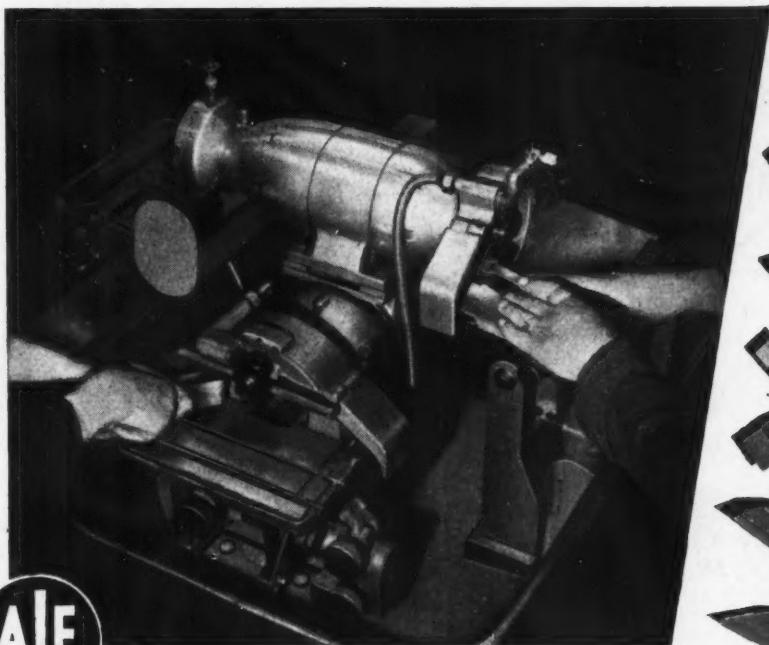
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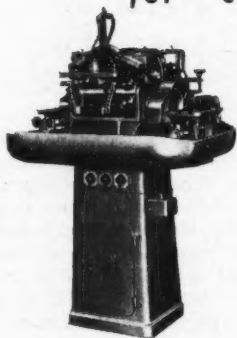
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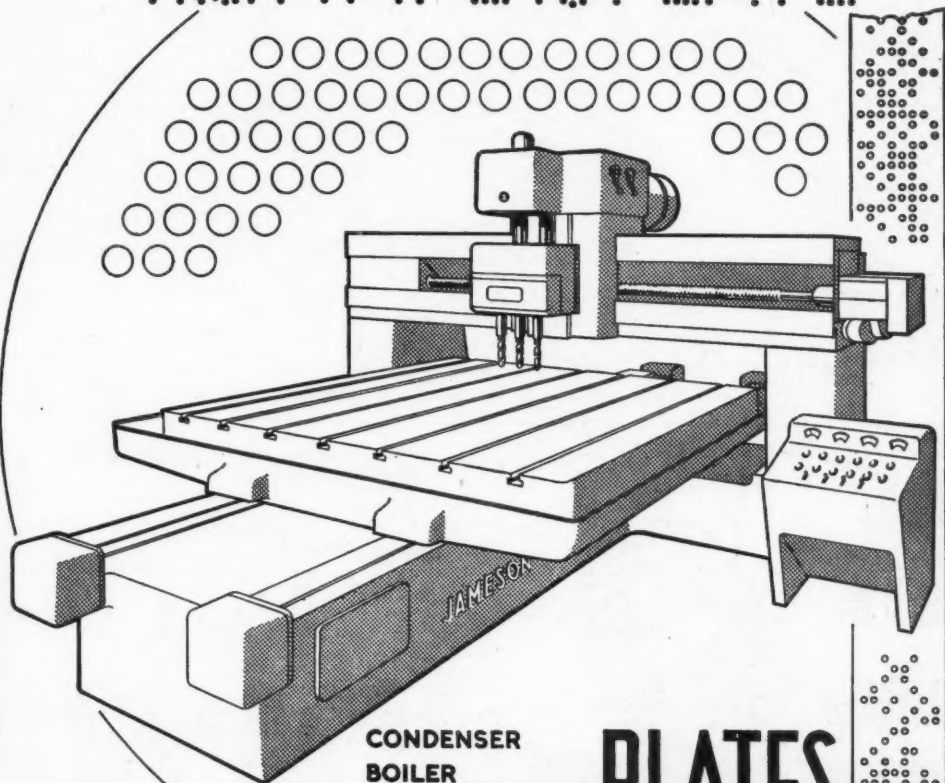
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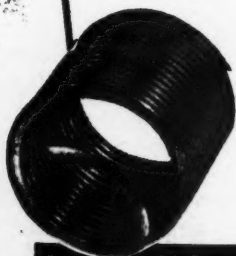
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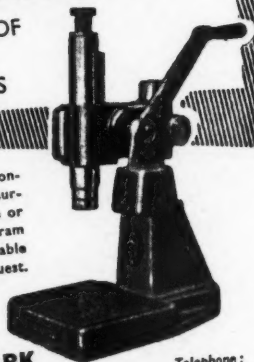
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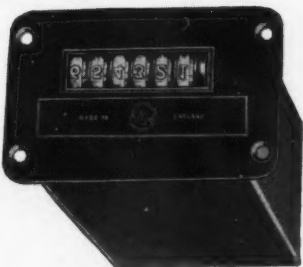




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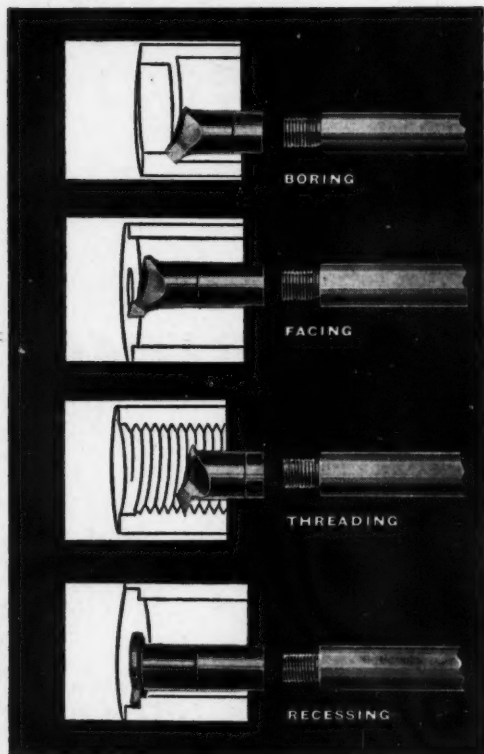
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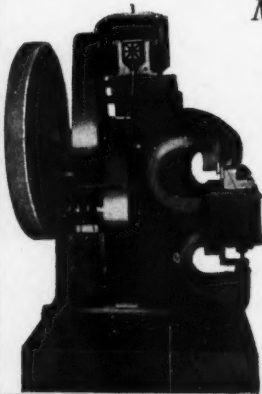
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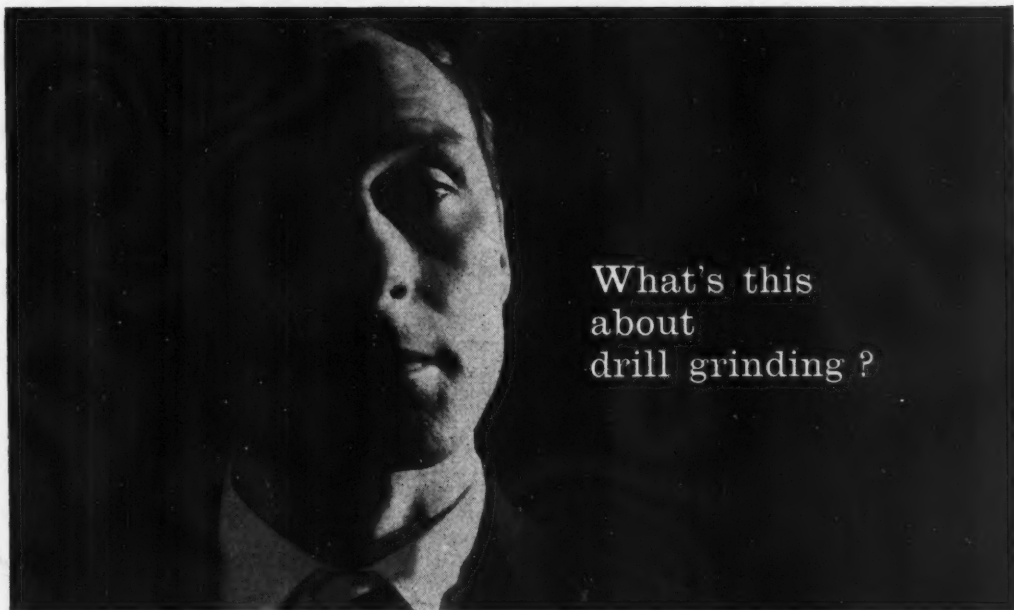


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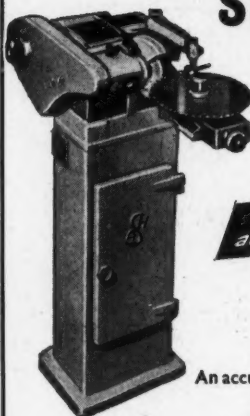
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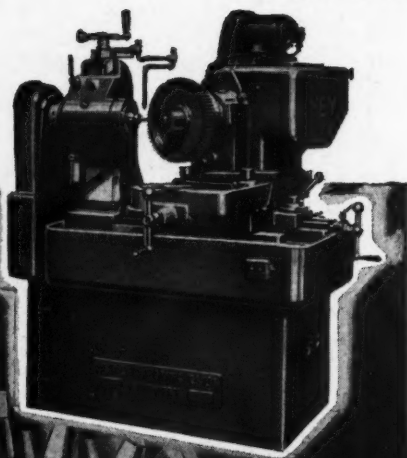
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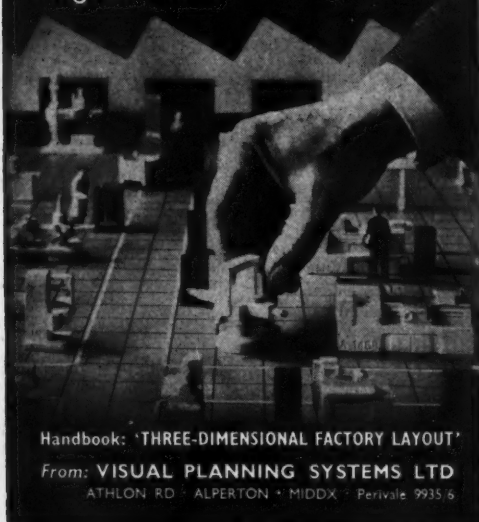
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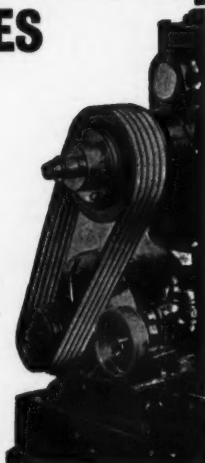
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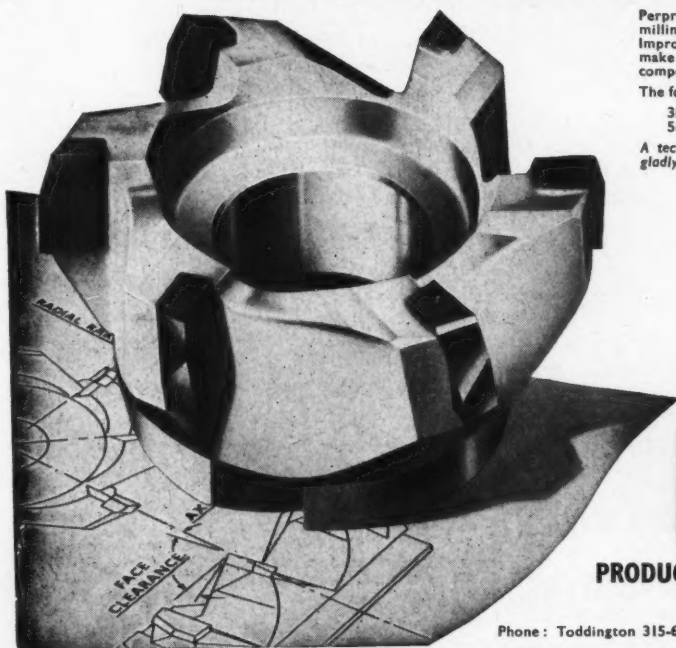
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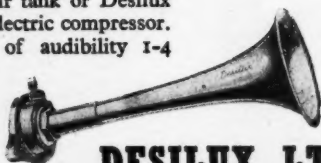
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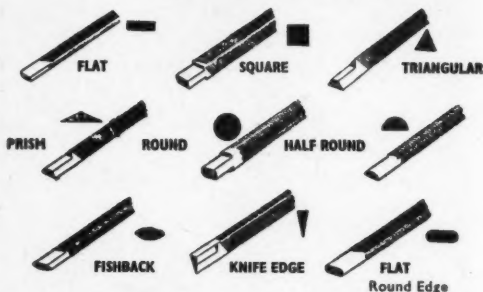
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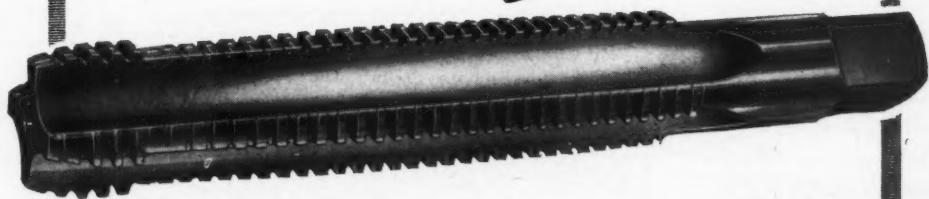
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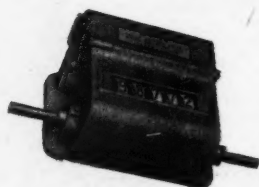
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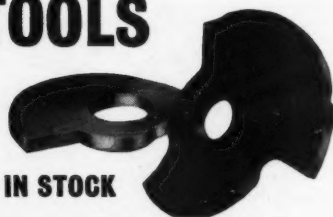
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Singles, small or long runs. Quick service.  
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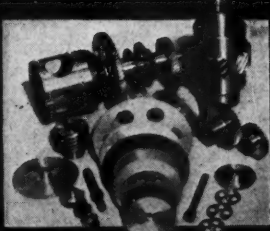
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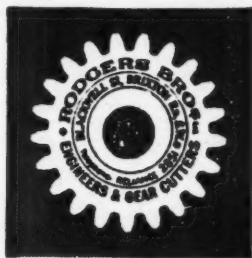
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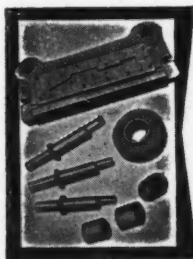
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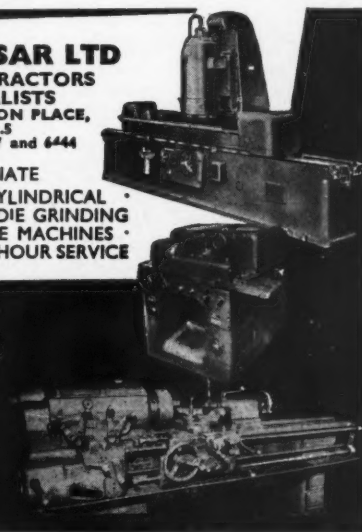
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Send your specification to:

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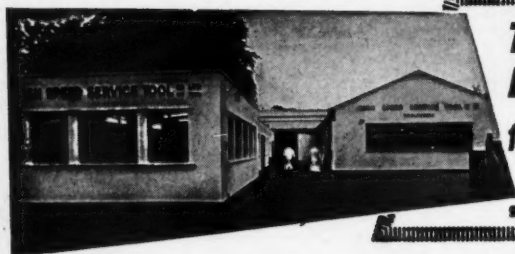
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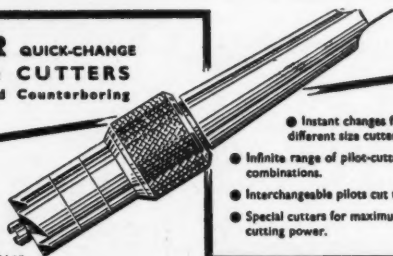
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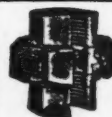
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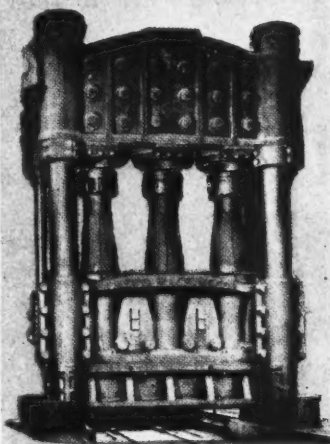
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covered bed, 25in. concentric chuck, 27in.  
4-jaw independent chuck. Good turret  
tooling, taper turning attachment, 35 h.p.  
motor, 400/3/50. Modern machine. Excel-  
lent equipment.

**OLDFIELD & SCHOFIELD** 32in. Swing  
Gap Bed S.S. & S.C. Lathe, 10ft. between  
centres, swing in gap 50in. × 16in. Taper  
turning attachment.

**MITCHELL** 8 1/2in. Centres Gap Bed S.S. & S.C.  
Lathe. Several available. All As New.  
52in., 54in. and 64in. between centres.

**PEARNS-RICHARDS** PRT2N Horizontal  
Boring and Facing Machine, 3in. dia. reversing  
spindle, chain drive to head, 400/3/50.

## HERBERT

# WIDDOWSON

& SONS LTD.

CANAL STREET, NOTTINGHAM

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CONOMATIC (U.S.A. Built) 4 Sp. 4½ in. Cap.  
GREENLEE 6 Sp. 1½ in. Cap.  
CONOMATIC 6 Sp. 1½ in. Cap.  
B.S.A. GRIDLEY 4 Sp. ½ in. Cap.  
GRIDLEY 6 Sp. ½ in. Cap. (Choice of two.)  
HERBERT No. 4 Chucking.

### BORERS

**Horizontal**  
PEARNS RICHARDS No. 3.  
RICHARDS HB. 2A 3 in. Travelling Spindle  
(choice of four).  
KEARNS OC. 2½ in. Travelling Spindle (choice  
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**Vertical**  
CRAVEN 36 in. heavy duty, side head,  
elevating cross rail, rapid feeds.

### GRINDERS

CHURCHILL 20 in. × 96 in. Hyd. Cylindrical.  
S/N20468.  
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LANDIS 3½ in. × 18 in. Plain Cylindrical.  
CHURCHILL 16 in. by 72 in. Universal.  
CHURCHILL 12 in. × 50 in. Hyd. Universal,  
internal spindle.  
FITCHBURG 12 in. × 32 in. Universal.  
JONES & SHIPMAN 8 in. × 16 in. Universal,  
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GLEASON 12 in. Single Roll. Roughing and  
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MAAG S560X Max. Dia. 17½ in.; Max. DP2.  
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MICHIGAN Gear Lapper. S/N2280.

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ARCHDALE 4 ft. 0 in.; 60 to 1,500 r.p.m.  
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ASQUITH ODI 4 ft. 0 in.; 16 to 430 r.p.m.  
ASQUITH ODI 4 ft. 0 in.; 31 to 850 r.p.m.

ASQUITH 4 ft. 6 in.; 31 to 850 r.p.m. (choice of  
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KITCHEN & WADE 4 ft. 0 in. Bridge Type.

**Single Spindle**  
ASQUITH 2 in. Cap.; 31/850 r.p.m. Column  
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**Multi Spindle**  
BARNESDRILL 16 Sp. ½ in. Cap.  
ARCHDALE 12 Sp. ½ in. Cap. F. Cluster.

### LATHES

**Centre**  
SWIFT 13 in. by 132 in.; 3.6 to 220 r.p.m.  
Straight Bed.  
SPRINGFIELD 12 in. by 48 in.; 9 to 380 r.p.m.  
Straight Bed.  
SCULFORTH 12 in. by 70 in.; 12.5 to 1,000 r.p.m.  
DEAN, SMITH & GRACE 12 in. by 66 in.; 19 to  
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PROGRESSIVE 11 in. × 120 in.; 20 to 516  
r.p.m. Gap Bed.  
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MONARCH 20 in. swing 96 in. B.C. 12 to  
180 r.p.m. Straight Bed.  
DEAN, SMITH & GRACE 8½ in. × 50 in.;  
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PROGRESS 8 in. × 60 in.; 23 to 1,050 r.p.m.  
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LIBBY 2H Comb. Hole in spindle 8 in.;  
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Power and rapid feeds to Saddle, Turret and  
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WARD 10B Comb. Power feed to Turret,  
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MILWAUKEE 2K, 15 to 1,500 r.p.m. (choice  
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ARCHDALE 20 in., table 40 in. by 10 in.; 60 to  
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CINCINNATI 2/24 Production.  
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HERBERT 28V, table 85 in. × 28 in.; 12 to  
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CINCINNATI 4 HP, table 78½ in. × 16½ in.; 17  
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ARCHDALE 18 in., table 38 in. × 10 in.; 79 to  
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KENDALL & GENT, table 5 ft. 0 in. × 4 ft. 0 in.  
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KENDALL & GENT, table 5 ft. 0 in. × 4 ft. 0 in.  
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BARNESDRILL 6 in. × 45 in. Vertical Honer.  
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BUTLER 12 in. Stroke Slotter with tilting  
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BUTLER 18 in. Stroke Super Shaping Machine.

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**CINCINNATI 10' × 3' × 3' Planer,**  
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**PLAUERT** Model H 100 Horizontal Boring and Facing Machine. Built 1949. Revolving Table 44in. by 49in. Facing head to end stay 9ft. 0in. approx. Spindle to table 48in. max. M.D. 420/3/50.

**LELAND-GIFFORD** 4-spindle Drill. T-slotted table 72in. by 22in. All spindles bored No. 3 M.T.

**ASQUITH** 7ft. Portable Universal Heavy Duty Radial Drill. Spindle No. 5 M.T.

**HEIDENREICH & HARBECK** Model 15 K.H.G. Bevel Gear Generator. Built 1952. Max. pitch 5in. M.D. 400/3/50.

**NEW LUMSDEN** Model 30R.S. Double Ended Tool Grinder. Wet model. Wheels 14in. by 3in. with 24in. centres. Four canting work rests, suds pump, etc. Drive by integral 2 H.P. motor 400-440/3/50.

**SNOW** Vertical Spindle Surface Grinder. Hydraulic table traverse up to 64in. 12in. segmental wheel. With 10in. by 54in. magnetic chuck. M.D. 415/3/50.

**PRECIMAX** U.P.J. Universal Grinder. Cap. 12in. by 60in. Hydraulic. M.D. 400/3/50.

**CHURCHILL** No. 1 Planetary Grinder. Cap. with largest spindle 10in. dia. by 18in. long. M.D. 400/3/50.

**WARD 2A** Capstan with Taper Turning. Swing over bed 11in.; over cross slide 6in. A.G.H. 12 speeds 48-2,041 r.p.m. Spindle bore 1in. Quantity of equipment. M.D. 400/3/50.

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**SWIFT** 10in. Gap-bed S.S. & S.C. Lathe. Admits 7ft. 6in. between-centres and 36in. dia. in gap. A.G.H. 27 speeds 9-420 r.p.m. With taper turning attachment. Four-jaw chuck and faceplate.

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**FRITZ WERNER** Model 8101 Manufacturing Millers. Table 36in. by 12in. Long. traverse 20in. 16 speeds 45-2,240 r.p.m. by change gears with fully automatic cycle. M.D. 415/3/50.

**CINCINNATI** 34/36 Duplex Hydromatic Miller. Table 64in. by 16in. Hydraulic traverses 36in. with rack variator. Two-way cycle. Admits approx. 20in. between spindle. Hydraulic lift to heads. M.D. 400/3/50.

**REED PRENTICE** No. 5 Vertical Miller. Kneeless type. Table 68in. by 16in. With long. power traverse 16in. also Q.P.T. 18 speeds 17-600 r.p.m. With 20in. power operated circular table.

**MAGEE** No. 10 Wiring and Edging Machine. Capacities (max.) 14's gauge sheet and 4in. wire or 16's gauge sheet and 7in. wire (min.) 24's gauge sheet and 10's gauge wire.

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**H. BELL (Machine Tools) LTD., Walter Street, LEEDS 4.**



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**NORTON** Universal Grinding Machines sizes 12in. by 36in. and 14in. by 36in.

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**ORMEROD** 24in. Shaping Machine.

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Further details from:—  
C. & G. OLDFIELD, Ltd.,  
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**Newall** 24in. x 36in. Jig Borer with comprehensive equipment—first class condition.—G. DUGARD, Ltd., Denmark Villas, Hove 32471

## AUTOS

**CONOMATIC** 1 1/2in. 8-spindle Type W.W.  
**WICKMAN** 2 1/2in. 5 spindle Auto. 1941 machine.

## BORERS

**UNION** Model BFT 100/11. 4in. spindle.

## DRILLING

**ASQUITH** 4ft. O.D.1 Radial Drill.  
**PROGRESS** 5 1/2 Round Table.  
**ARCHDALE** 28in. Heavy Duty Pillar Drill.  
**NEW-MAS** Model V.R.2, 3ft., Elevating Arm Radial Drill.  
**MAS** Model V.R.4, 4ft. 6in., Elevating Arm Radial Drill.

## LATHES

**SOUTHBEND** 16in.  
**EDGWICK** 7in.  
**DEAN, SMITH & GRACE.** Height of centres 7in.  
**MONARCH** 22M, S.S. Taper Turning Lathe.  
**WARD** 10 Combination Turret Lathe.  
**WARD** 7 Combination Turret Lathe.  
**LANG** 10in. Gap Bed. 5ft. between.

## MILLING

28in. **ARCHDALE**, Rapid all ways.  
18in. **EDGWICK** Production Mill.  
**CINCINNATI** No. 5 High Power Plain Hor. 1942 machine.  
**MILWAUKEE** 2 HL Vertical—rebuilt.  
**MILWAUKEE** 2K Plain—overhauled.  
**MILWAUKEE** 3KM Universal, metric, with dividing head.  
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**KENDALL & GENT** Model C.V.M. 25.  
**NEW-GIERWOT** Model F.Y.C. 25 No. 2 Vertical Miller, 44 x 10in. table. Delivery mid-October.

## GRINDING

**NEW-RIBON** Model R.V.R.1000, 10 x 40in.

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**TRIUMPH** 6ft. x 4in. Overcrank.  
All machines motorised 400/3/50

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**New for Immediate Delivery**  
**CENTEC** Model 2B Precision Milling Machine. Power feed to Table.

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**10in. x 24in. Churchill Model**  
FAH Hydraulic Universal and Tool and Cutter Grinding Machine with rise and fall wheelhead. Fully motorised, 400/3/50. Variable hydraulic motion 6in.-180in. per min. Modern machine in ex. order.—LEE & HUNT Ltd., Crocus Street, Nottingham. Phone 84246.

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**TOWN** 28in. Vertical Spindle Drilling Machine. Compound table. 400/3/50.

**K. & W.** 38in. Sensitive Radial Drilling Machine. Swing-aside table, swing-aside arm. 400/3/50.

**JONES & SHEPMAN** 20in. Vertical Drilling Machine. No. 4 Morse Taper. Power feed. 400/3/50.

**KEARNS** No. 2 Standard Horizontal Boring Machine with facing head and sliding spindle. 400/3/50.

**SNOW** T20 Table Surface Grinding Machine.

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# ROLLS TOOLS LTD.

## OF WOKING SURREY

### ATUOMATICS

**B.M.W.13** 13mm. single spindle.  
**PITTLER** 12 mm. Swiss type.  
**AEB BECHLER** 4 tools, 2 spindle attachment, slotting attachment.  
**AE4 BECHLER** 1 spindle attachment.  
**2 GIBBS** Swiss Type  $\frac{1}{2}$  in. Capacity.  
**CLEVELAND** Model A.  $2\frac{1}{2}$  in. capacity.

### MULTI SPINDLE AUTOMATICS

$\frac{3}{4}$  in. **B.S.A. ACME GRIDLEY RA6** spindle. Screwing spindle, Collets and Tooling. 3 available. 1944-1948.  
 $1\frac{1}{2}$  in. **CONOMATIC** 8 spindle with screwing spindle, thread rolling, tooling and collets.  
 1 in. **NEW BRITAIN GRIDLEY** 6 spindle, Model 60.  
 $1\frac{1}{2}$  in. **ACME GRIDLEY** 6 spindle Bar Auto.  
 $\frac{3}{4}$  in. **ACME GRIDLEY** 4 spindle, G Model Bar Auto. £450.

### COMPRESSORS

New **B.E.N.** Compressors in stock, type VR 32 cfm, 100 lb. working pressure and type VR 41 cfm 100 lb. working pressure.

### CUTTING OFF MACHINES

**BALLINGER** Abrasive type C.  
**CLIFTON & BAIRD** Cold Saw, Hydraulic feed. Saw 18 in. dia. and clamp.

### DRILLS

**HERBERT J TYPE.** Single Column and two column machines.  
**ARCHDALE** Snout Type Electrically Controlled Vertical Borer. 50 Int. Taper.  
**LELAND GIFFORD** 2 Spindle No. 2 Morse Taper.  
**ASQUITH** Horizontal Duplex M/c. No. 5 Morse, 5ft. dia. Rotary table.  
**ARCHDALE** 2 spindle, mounted on a bridge with swivelling and centre distance adjustment. Power traverse to quills. No. 4 Morse. Table 92 in. by 13 in. working surface.  
**CORONA** 2 Spindle 15CK, No. 3 Morse.

### LAPPING MACHINES

**HAHN & KOLB** 26 in. dia. with Coolant Filter Plant. Reconditioned.  
**PETER WOLTERS** Hydraulic. Two Spindle Vertical Honing Machine.

### RADIAL DRILLS

**TOWN** 5ft. Radial.

### Radial Drills (cont.)

**KITCHEN & WADE** 40 in. Arm. Power Rise and Fall. Speeds 1,500 r.p.m., No. 3 Morse. Suds.  
**ARCHDALE** Light Sensitive 36 in. Rise and Fall Table. No. 3 Morse.  
**ASQUITH** 6ft. D.C. Drive. £400.  
**ASQUITH** OD2. 8ft.

### GEAR HOBBING MACHINES

**PFAUTER** type R00.  
**MIKRON** type 79.  
**CLEVELAND** 130D.  
**BARBER COLMAN** No. 3.  
**GLEASON** 3 in. Bevel Gear Generator and equipment.  
**LORENZE** S00 High Speed Gear Shaper, Rebuilt.

### GRINDERS—CYLINDRICAL

**PRECIMAX** SP  $1\frac{1}{2}$  7 in. by 12 in. Recond.  
**PRECIMAX** MPO., 6 in. by 24 in. Plunge  
**NORTON** 6 in. by 24 in.  
**CHURCHILL** 6 by 18 Hydraulic feed, hydrauto bearings.  
**CHURCHILL** 10 in. by 48 in.

### GRINDERS—SURFACE

**SNOW** VB. 18, 72 in. Traverse by 15 in. wide.  
**DOALL** 20 in. by 6 in. Hydraulic Feed.  
**JONES & SHIPMAN** Fig. 540. 6 in. by 18 in.  
**BLANCHARD** 10C. 16 in. Magnetic Rotary Table.

### GRINDERS—UNIVERSAL

**JONES & SHIPMAN** 10 in. by 27 in.  
**LANDIS** 12 in. by 36 in.  
**HENRI KAESER** Model L. 10 by 20.  
**BROWN & SHARPE** No. 13.

### LATHES

**BINNS & BERRY** A.G.H. 10 in. centres & 6ft. between, 36 in. in gap. Speeds 22-490.  
**PRATT & WHITNEY** A.G.H. 6 $\frac{1}{2}$  in. by 30 in.  
**TRIDENT** Gap Bed Lathe. 6 $\frac{1}{2}$  in. by 30 in.  
**WARD HAGGAS & SMITH** faceplate Lathe, 57 in. swing, 64 in. in gap. Short bed with adjustable gap.  
**LE BLOND** Production Lathe, 7 in. centres by 36 in. between.  
**TRIDENT** Gap Bed 6 $\frac{1}{2}$  in. by 60 in.

### CAPSTAN AND TURRET LATHES

**HERBERT** No. 4, Senior Eloptive.  
**HERBERT** No. 0.  
**HERBERT** No. 13 Bar Turret.  
**GISHOLT** No. 3 A.G.H. Capstan (Collet).

All Electrics 400/3/50.

### Capstan and Turret Lathes (cont.)

**GISHOLT** No. 3 Simplified Capstan.  
**GISHOLT** IL 3 in. hole through spindle.  
**LIBBY** Turret 5 in. hole through spindle.  
**ATLAS** ID 1 in. capacity.  
**MODERN** No. 1.  
**MURAD** 3Q  $\frac{3}{4}$  in. capacity.  
**WARNER & SWASEY** No. 1.  
**WARD** No. 7 Capstan Lathe, covered bed, air chucking. Equipment fitted.  
**WARD** 3A Capstans.  
**WARD** 2A Capstans.

### MILLING MACHINES

**CINCINNATI** 08 Vertical.  
**THIEL** Model 58 Tool Room Mill.  
**WADKIN** High Speed Vertical, Table 35 in. by 13 in.  
**CINCINNATI** No. 3 Vertical Sliding head.  
**ALEXANDER** No. 2, 3 Dimensional Pantograph Machine.  
**CENTEC** 2A Horizontal.  
**HERBERT** No. 1 Hand Mill.

### MILLERS THREAD

**HILLE** 6 in. O/D Max.  
**MATTERSON** No. 11.  
**HANSON WITNEY** 9 in. by 4 in.  
**WICKMAN** Moulton.  
**ARCHDALE** with 120 Hobs.  
**WANDERER** 3 in. capacity.

### PRESSES

**TAYLOR & CHALLEN** Type 1413 40 ton Variable stroke—Guards.  
 85-ton **RHODES** Upright Geared.  
 16-ton **RHODES** Inclinalable.  
 25-ton **RHODES** Inclinalable.  
 35-ton **RHODES** Inclinalable.  
**BLISS** No. 8 Power Press.  
**FLY PRESSES** Nos. 3, 4, 5, 6.  
**HENRY & WRIGHT** Dieing Press, 25 tons.  
**L.M.E.** 12-ton variable stroke, pneumatic operator's guard.

### SHAPERS

**ESSEX** Punch Shaper with Microscope and equipment.  
**ALBA** 14 in. stroke.  
**ALBA** 10 in. stroke.

### SLOTTERS

**BUTLER RAPID** 8 in. Tool Room Machine.  
**BUTLER PRECISION** 4 in.

**ROLLS TOOLS LTD.** No. 1 Factory, Pyrford Road, Pyrford, Woking

Contact Mr. P. W. Gander Telephone: Byfleet 43252/3 & 41456

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# PIDGEN BROS. LIMITED

## HELMET ROW, OLD STREET, LONDON, E.C.1

Telephone: CLerkenwell 6481

ALL MACHINES MOTORISED FOR 3 PHASE SUPPLY UNLESS OTHERWISE STATED

**AUTOS**

WICKMAN 10 mm.  
GREENLEE 1in. x 6 spindle.  
**BORERS (Horizontal)**  
KEARNS No. 2.

**BROACHING**

AMERICAN model H2, stroke 30in.

**CAPSTANS**

MURAD 4in.  
HERBERT 4B and 4.  
**CUTTING OFF MACHINES**  
TAYLOR 10in.

**DRILLS**

NATCO 24 spindle No. 1 M.T.  
CORONA Type 100X 2 spindle.  
HERBERT 2 spindle.  
ARCHDALE 3ft. Radial No. 3 M.T.  
HERBERT 24in. B.G.  
HERBERT "C" Power Feed.  
CORONA No. 21 AR, No. 3 M.T.  
JONES & SHIPMAN 816, 7in. cap.  
CORONA IAX, No. 2, Morse Taper.  
LELAND GIFFORD 2-sp., No. 2 M.T.  
HERBERT Type B, Single Spindle, 7in.  
CORONA 6MX Cluster Type.  
HERBERT Type H, 7in. cap.

**ENGRAVERS**

T.T. & H. 3 dimensional.  
ALEXANDER No. 2, 3-dimensional.  
LIENHARD 3-dimensional. (New)  
LIENHARD No. 1H.  
HUFFIELD Router.  
T.T. & H. Type C, C.B. and M.A.  
T.T. & H. Multi Etcher.

**FILING AND SAWING MACHINES**

MIDSAW 22in. Bandsaw.  
JONES No. 13 Bandsaw.  
WICKSTEAD No. 1 Hacksaw.  
RAPIDOR 6in. Hacksaw.  
RAPIDOR Filing and Sawing.

**FOLDERS**

Sheet Edging, 30in. x 22g.  
**GEAR CUTTERS**  
SAFAG Pinion.  
MAXICUT 7in. x 2in. x 6 D.P.  
PETERMAN No. 1 and 2.  
**GRINDERS (Internal)**  
NOVA A, with facing head.  
CHURCHILL HBY.  
BRYANT 16/38 and 5.

**GRINDERS (Surface)**

CHURCHILL OSB 8in. x 30in.  
LUMSDEN Vert. 210 XXM.  
ABRASIVE No. 34 Vertical Spindle.

**GRINDERS (Cylindrical)**

CHURCHILL 6 x 36in. B.Y.  
CHURCHILL PBH 12 x 36in. Univ.  
NEWALL 6 x 18. Model XL.

**GRINDERS (Miscellaneous)**

BROWN & SHARPE No. 10 and 13 T. & C.  
J. & S. "Perfect Point" 0-010in.-7in. Drill.  
JONES & SHIPMAN, 10in. x 27in. T. & C.  
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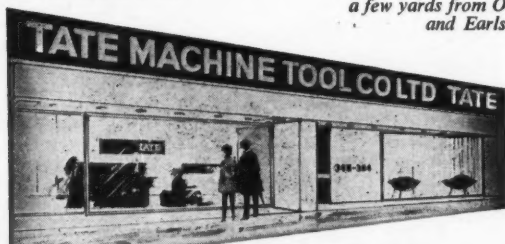
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No. 2 **KEARNS** Horizontal Borer.

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**CINCINNATI** No. 1M Vertical Milling Machine.

**PRATT & WHITNEY** Model BL3620 3-spindle "Keller" Die Sinking Machine.

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Crossfeed coarse traverse graduations in .000225in. .05625in. per rev

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Milling Machine. Table size 38in. x  
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Max. pressure by both slides, 90 tons. Punch  
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ised 400-440/3/50.**TAYLOR & CHALLEN No. 31DGP Double**  
Sided Double Geared Double Action Cam  
Action Drawing Press. Punch stroke 10in.  
Blankholder stroke 54in. Between uprights  
22in. Bed 20in. x 194in. Blankholder 12in.  
dia. Punch 5in. dia. Bed fitted with ejector.  
Operator's guard. Arranged motor drive  
400-440/3/50.**BLISS No. 85 Double Geared Double Sided**  
Reducing Press, with straight slides. Pressure  
about 50 tons. Stroke 144in. Between  
uprights 22in. Bed 21in. x 21in. Hole in  
bed 94in. dia. Spare crankshaft with 5in.  
stroke. Friction clutch. Arranged motor  
drive 400/3/50.**BLISS No. 18 Inclined Press with single roll**  
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knurled feed rollers 2in. dia. x 2in. wide.  
Arranged motor drive 400/3/50.**Double Sided Friction Screw Press with cast**  
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between uprights 224in. Tee-slotted bed  
194in. x 204in. Tie bar construction.  
Arranged motor drive 400/3/50.**NEW LEN.63/250 Open Fronted Geared**  
Inclined Power Presses with adjustable  
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63 tons. Depth of throat 11in. Size of table  
204in. x 294in. Arranged motor drive  
400-440/3/50.**HOLROYD Motorised Toggle Action Rivet**  
Punching Machine with power lift to table.  
Capacity 4in. diameter rivets. Stroke of  
ram 34in. Depth of gap 5in. Arranged  
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CATALOGUES: Price 1s. each (Postal Orders only) to admit TWO persons to view and ONE person to the sale, may be obtained from the Auctioneers' Offices (Dept. 7), Byard Lane, Nottingham, from the 7th October onward Tel. Nottingham 54272 (7 lines).

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**Development Engineer Draughtsman** required for progressive tool and machine manufacturing company in Stafford. The situation offers an exceptional opportunity for a forward thinking man to develop into a very senior executive.—Apply in writing to **MANAGING DIRECTOR, STAFFORD TOOL & DIE CO. LTD.,** Gainsborough Works, St. Patrick's Place, Stafford.

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**Works Manager required by** progressive Engineering Company specialising in Hydraulic Presses, etc. Must be a fully experienced Engineer, have good administrative ability and able to control staff. First class prospects for the right man.—Apply in confidence giving full particulars and expected salary to **BOX D245, MACHINERY,** Clifton House, Euston Road, N.W.1.

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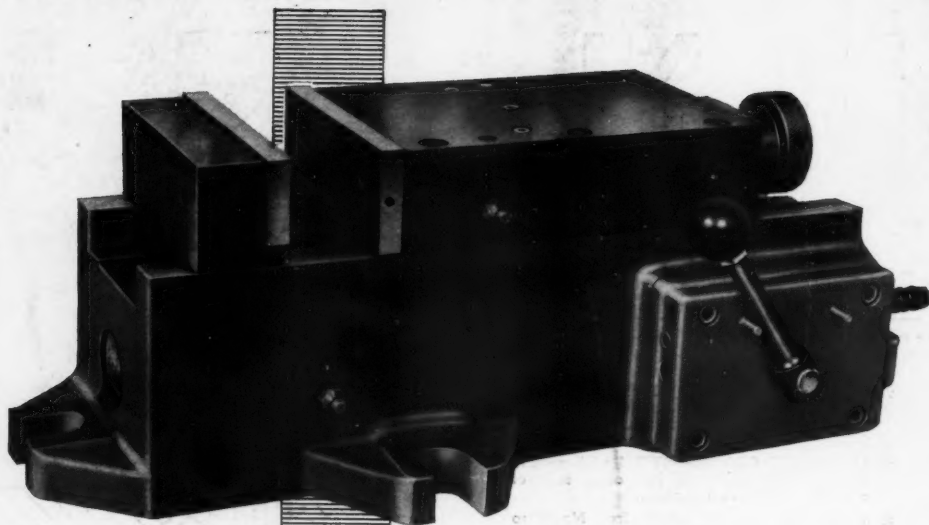
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Minimum Opening	0"	1½"
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